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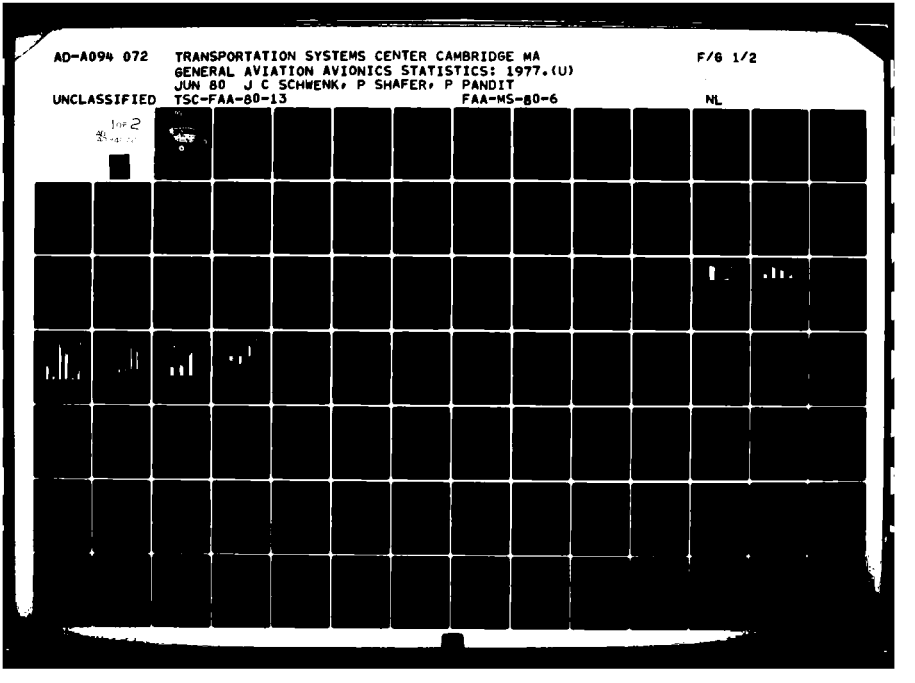

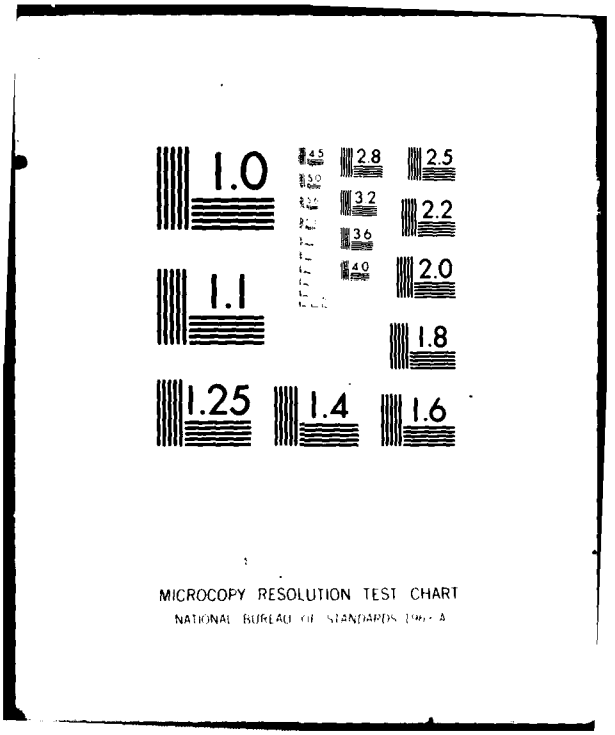

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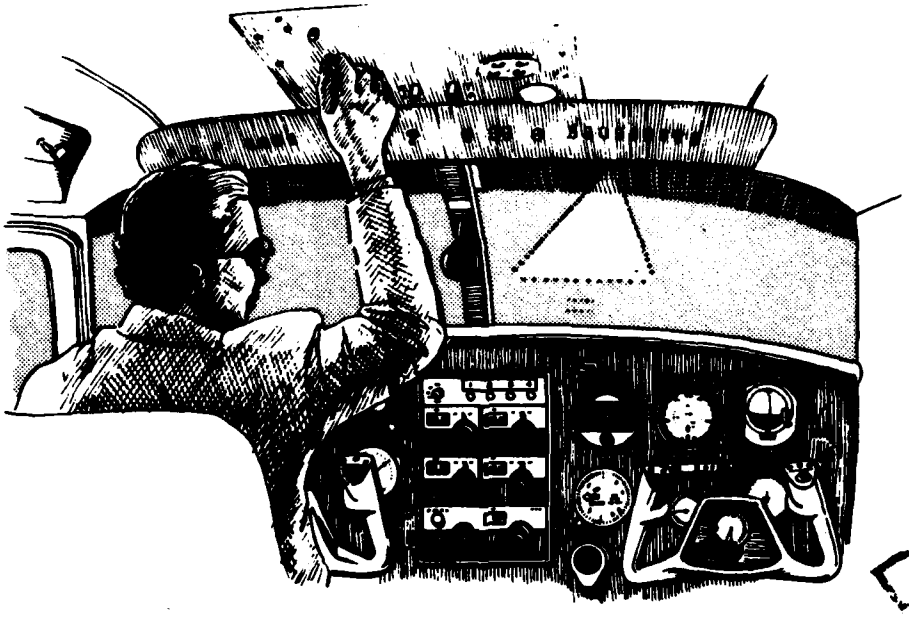

JUNE 1980

ANNUAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION
OFFICE OF MANAGEMENT SYSTEMS
INFORMATION AND STATISTICS DIVISION

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16. Abstract

This report presents avionics statistics for the 1977 general aviation (GA) aircraft fleet and is the fourth in a series titled General Aviation Avionics Statistics. The statistics are presented in a capability group framework which enables one to relate airborne avionics equipment to the capability for a GA aircraft to function in the National Airspace System. The word "capability" is used in this report to mean in what segments of the airspace an aircraft can fly, under what flight rules it can fly, and at what airports it can land. The framework permits the GA fleet to be divided into groups according to their capabilities as dictated by the avionics configurations of the aircraft. Differences in various characteristics of the aircraft are examined among the capability groups. The FAA's Sample File of results from the 1977 GA Activity and Avionics Survey is the source of all the statistical data used in this report.

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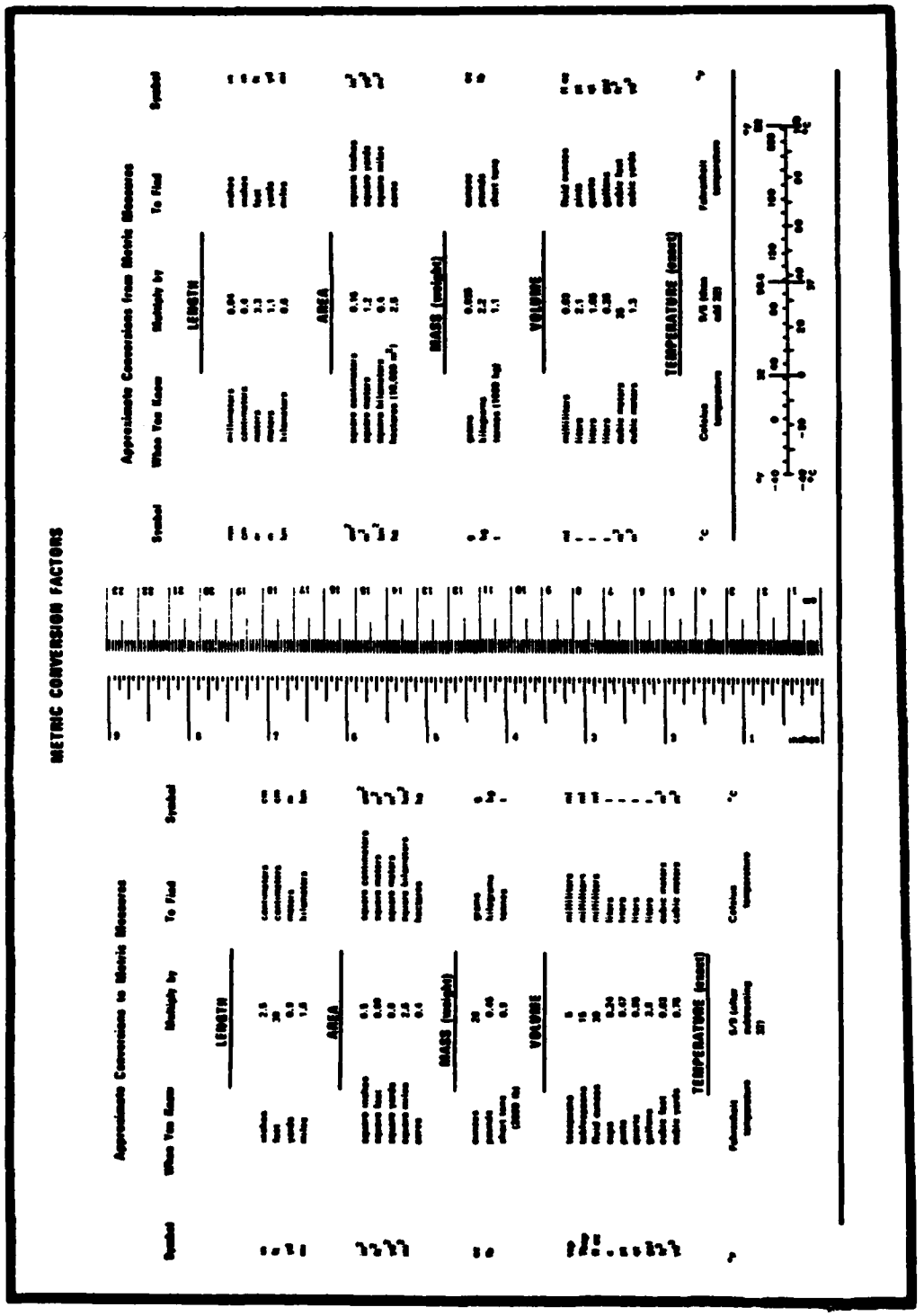
METRIC CONVERSION FACTORS
Approximate Conversions to Metric Measures
Symbol
When You Know
Multiply by
To Find
Symbol
LENGTH
inches
2.5
centimeters
cm
feet
30
centimeters
cm
yards
0.9
meters
m
miles
1.6
kilometers
km
AREA
square inches
6.5
square centimeters
cm²
square feet
0.09
square meters
m²
square yards
0.8
square meters
m²
square miles
2.6
square kilometers
km²
acres
0.4
hectares
ha
MASS (weight)
ounces
28
grams
g
pounds
0.45
kilograms
kg
short tons (2000 lb)
0.9
tonnes
t
VOLUME
teaspoons
5
milliliters
ml
tablespoons
15
milliliters
ml
fluid ounces
30
milliliters
ml
cups
0.24
liters
l
pints
0.47
liters
l
quarts
0.95
liters
l
gallons
3.8
liters
l
cubic feet
0.03
cubic meters
m³
cubic yards
0.76
cubic meters
m³
TEMPERATURE (exact)
Fahrenheit temperature
5/9 (after subtracting 32)
Celsius temperature
°C
Approximate Conversions from Metric Measures
Symbol
When You Know
Multiply by
To Find
Symbol
LENGTH
millimeters
0.04
inches
in
centimeters
0.4
inches
in
meters
3.3
feet
ft
meters
1.1
yards
yd
kilometers
0.6
miles
mi
AREA
square centimeters
0.16
square inches
in²
square meters
1.2
square yards
yd²
square kilometers
0.4
square miles
mi²
hectares (10,000 m²)
2.5
acres
MASS (weight)
grams
0.035
ounces
oz
kilograms
2.2
pounds
lb
tonnes (1000 kg)
1.1
short tons
VOLUME
milliliters
0.03
fluid ounces
fl oz
liters
2.1
pints
pt
liters
1.06
quarts
qt
liters
0.26
gallons
gal
cubic meters
35
cubic feet
ft³
cubic meters
1.3
cubic yards
yd³
TEMPERATURE (exact)
Celsius temperature
9/5 (then add 32)
Fahrenheit temperature
°F
inches
cm

PREFACE

This report describes the 1977 avionics data study performed by the Transportation Systems Center (TSC) and Wilson Hill Associates, Inc., under Project Plan Agreement FA-043 sponsored by the Federal Aviation Administration (FAA), Office of Management Systems, Information and Statistics Division. It is the fourth in the series General Aviation Avionics Statistics, which TSC produced for the same sponsor and which contains the groundwork for future issues. TSC performed the previous studies as part of a continuing program to assure the quality and usefulness of general aviation data. The study is based on information collected by the FAA and processed by the TSC.

The authors would like to acknowledge the contributions to this report by several people: Carolyn Edwards of FAA-AMS-220, assisted and guided the project as sponsor; Paula Shafer and Preeti Pandit of Wilson Hill Associates were responsible for manipulating the data, writing the computer programs to produce the tables appearing in this publication, and performing the data analysis.

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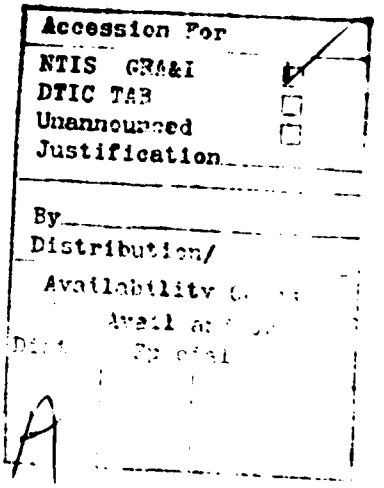

EXECUTIVE SUMMARY

This document is the fourth in the General Aviation Avionics Statistics report series, and presents avionics statistics and other descriptive information for the 1977 general aviation (GA) aircraft fleet. The report series results from a study which was designed first, to develop a framework for the GA fleet relating airborne avionics equipment to aircraft capability to perform in the National Airspace System (NAS), and second, within this framework to analyze the activity and other characteristics of the GA fleet.

The source of data for the study was the FAA's 1977 Sample File of results from the GA Activity and Avionics Survey, conducted in 1978 by the Federal Aviation Administration to obtain information on the activities and avionics of the 1977 general aviation aircraft fleet, the major component of civil aviation in the United States. The FAA selected a statistically designed sample of about 14.4 percent of the registered general aviation fleet to participate in the survey. The sampled aircraft represented all states and FAA regions, and all of the major manufacturer - model groups of aircraft.

In developing the framework for analyzing capabilities of the GA fleet, the main assumption was that the avionics equipment contained in an aircraft determined the maximum capabilities of that aircraft to perform in the NAS.

The word "capability" was used to mean where and under what type of flight rules an aircraft could fly, at what airports it could land, and to what extent it could participate in various navigation, communication, and landing systems. Capability groups were defined, each group consisting of a combination of avionics equipment and the associated capabilities. By assigning each GA aircraft to its appropriate capability groups according to its avionics configuration, and then studying the differences in characteristics among the groups, relationships between the level of avionics in an aircraft and other physical and operating characteristics could be drawn.

Some of the significant findings, based on the 24,498 sampled GA aircraft for which avionics information was available, are listed below:

- While only about 16 percent of the GA fleet have the avionics equipment required to fly above 18,000 feet in positive controlled airspace, this number has grown nearly 120 percent since 1974.
- Almost 76 percent of the GA fleet can fly Instrument Flight Rules (IFR).
- Over 20 percent of the GA fleet can land at Group I Terminal Control Areas (TCA's).
- At least 47 percent of the GA fleet have some degree of instrument landing system (ILS) receiving capability.
- From 1976 to 1977 there was a 17 percent increase in the proportion of aircraft with avionics equipment enabling them both to land at Group I TCA's and to fly in positive controlled airspace.

As the level of avionics in an aircraft increases,

- primary uses change from mostly personal to mostly business and executive,
- the type of aircraft becomes more sophisticated,
- the aircraft usage (number of hours flown) increases,
- the age of the aircraft decreases.

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1. INTRODUCTION

1.1 DEFINITIONS

1.1.1 General Aviation (GA)

The term "general aviation" is defined for the purposes of this report as all aircraft in the U. S. civil air fleet except those operated under Federal Aviation Regulations (FAR) Parts 121 and 127. These two parts cover the operations of fixed wing aircraft and rotorcraft, respectively, that 1) have been issued a certificate of public convenience and necessity by the Civil Aeronautics Board authorizing the performance of scheduled air transportation over specified routes and a limited amount of non-scheduled operations, and 2) are used by large aircraft commercial operators. General aviation thus includes aircraft operated under FAR:

Part 91: General operating and flight rules.

Part 123: Certification and operations: air travel clubs using large airplanes.

Part 133: Rotorcraft external load operations.

Part 135: Air taxi operators and commercial operators of small aircraft.

Part 137: Agricultural aircraft operations.

General aviation offers such varied services as air taxi, air cargo, industrial, agricultural, business, personal, instructional, research, patrol, and sport flying. General aviation aircraft range in complexity from simple gliders and balloons to four engine turbojets.

1.1.2 Avionics

The term avionics, as used in this report, refers to the airborne electronic equipment used by aircraft to transmit and receive various forms of radio signals for purposes of

navigation, communication, tracking, and landing the aircraft. Some examples are the VHF communications equipment which transmits and receives voice communications via very high frequency radio waves, and the radar altimeter which determines the aircraft's altitude above the terrain by bouncing radio waves off the ground below.

1.2 BACKGROUND

The General Aviation Avionics Statistics report series began with a report on the 1974 GA fleet. The report revealed the findings of a study designed first, to develop a framework for the GA fleet relating airborne avionics equipment to aircraft capability to perform in the National Airspace System (NAS), and second, within this framework to analyze the activity and other characteristics of the GA fleet. The 1977, 1976, and 1975 reports are updates of the 1974 report and follow the 1974 format to facilitate year to year comparisons.

The usefulness of such reports is easily established when one considers GA's dominance of the civil air fleet, and the scarcity of reliable information on GA activities. In calendar year 1977 GA aircraft comprised almost 99 percent of the U.S. civil air fleet,[1] and accounted for over 84 percent of civilian operations at FAA towered airports.[2] However, in contrast to the air carriers which account for the remaining civilian aircraft and operations, GA has no requirement for reporting activity and avionics information to the Federal government. Therefore one's knowledge of GA is confined to what can be extracted from the limited data available, acquired mostly through voluntary surveys. Analyses of the data and resulting inferences provide much needed insight into the nature of the GA fleet.

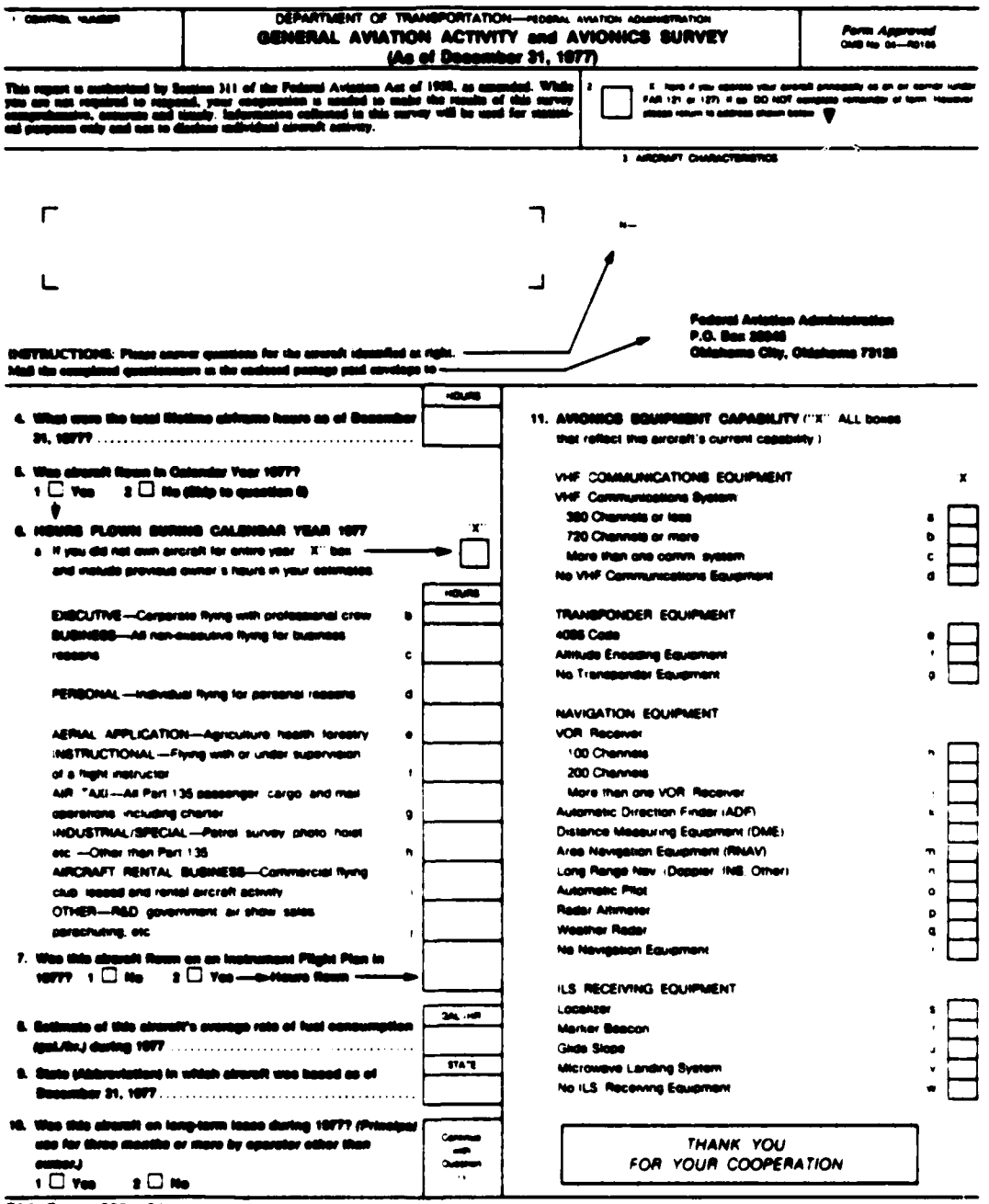
[1] Source: Census of U. S. Civil Aircraft Calendar Year 1977, U. S. Department of Transportation, Federal Aviation Administration (Washington DC, 1979), p.4.

[2] This figure includes operations for both GA and air taxi. Source: FAA Air Traffic Activity, Calendar Year 1977, U.S. Department of Transportation, Federal Aviation Administration (Washington DC, 1978), p. 2.

1.3 SOURCE OF DATA

The basic source of data for this report series is the owners of the GA fleet. For each of the years 1974, 1975, and 1976, the FAA collected GA activity and avionics data through a voluntary census of the owners of all GA aircraft using Part 2 of the annual Aircraft Registration Eligibility, Identification and Activity Report, AC Form 8050-73. For the 1977 report, FAA initiated a new method of obtaining GA activity and avionics data by conducting a sample survey of around 14-15% of the registered GA fleet. This annual survey is known as the General Aviation Activity and Avionics Survey. Figure 1 shows the 1977 questionnaire. For a detailed description of the survey design, see Appendix A.

In this report, because of the new survey method, activity and avionics figures are in the form of statistical estimates rather than exact counts. These figures have standard errors because they are based on information obtained from only a portion of the GA fleet which is expanded to form an estimate for the whole fleet. Appendix A contains a thorough description of the standard errors, their interpretation, and use. Results of the survey were compiled into a file known as the 1977 Sample File. A record layout appears in Appendix B.



DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION

GENERAL AVIATION ACTIVITY and AVIONICS SURVEY

(As of December 31, 1977)

Form Approved

This report is authorized by Section 311 of the Federal Aviation Act of 1958, as amended. While you are not required to respond, your cooperation is needed to make the results of this survey comprehensive, accurate and timely. Information collected in this survey will be used for statistical purposes only and not to disclose individual aircraft activity.

AIRCRAFT CHARACTERISTICS

INSTRUCTIONS: Please answer questions for the aircraft identified at right.
Mail the completed questionnaire in the enclosed postage paid envelope to

Federal Aviation Administration
P.O. Box 25082
Oklahoma City, Oklahoma 73125

4. What were the total lifetime airframe hours as of December 31, 1977? ..... HOURS

5. Was aircraft flown in Calendar Year 1977?
1 ☐ Yes 2 ☐ No (Skip to question 8)

6. HOURS FLOWN DURING CALENDAR YEAR 1977
a If you did not own aircraft for entire year "X" box and include previous owner's hours in your estimates ..... "X"

		HOURS
EXECUTIVE—Corporate flying with professional crew	b	
BUSINESS—All non-executive flying for business reasons	c	
PERSONAL—Individual flying for personal reasons	d	
AERIAL APPLICATION—Agriculture health forestry	e	
INSTRUCTIONAL—Flying with or under supervision of a flight instructor	f	
AIR TAXI—All Part 135 passenger cargo and mail operations including charter	g	
INDUSTRIAL/SPECIAL—Patrol survey photo hoist etc —Other than Part 135	h	
AIRCRAFT RENTAL BUSINESS—Commercial flying club leased and rental aircraft activity	i	
OTHER—R&D government air show sales parachuting, etc	j	

7. Was this aircraft flown on an Instrument Flight Plan in 1977? 1 ☐ No 2 ☐ Yes —▶ Hours flown .....

8. Estimate of this aircraft's average rate of fuel consumption (gal./lbs.) during 1977 ..... GAL./LBS.

9. State (Abbreviations) in which aircraft was based as of December 31, 1977 ..... STATE

10. Was this aircraft on long-term lease during 1977? (Principal use for three months or more by operator other than owner.)
1 ☐ Yes 2 ☐ No

Comments with Questions

11. AVIONICS EQUIPMENT CAPABILITY ("X" ALL boxes that reflect this aircraft's current capability.)

		X
VHF COMMUNICATIONS EQUIPMENT		
VHF Communications System		
360 Channels or less	a	
720 Channels or more	b	
More than one comm. system	c	
No VHF Communications Equipment	d	
TRANSPONDER EQUIPMENT		
4096 Code	e	
Altitude Encoding Equipment	f	
No Transponder Equipment	g	
NAVIGATION EQUIPMENT		
VOR Receiver		
100 Channels	h	
200 Channels	i	
More than one VOR Receiver	j	
Automatic Direction Finder (ADF)	k	
Distance Measuring Equipment (DME)	l	
Area Navigation Equipment (RNAV)	m	
Long Range Nav. (Doppler, INS, Other)	n	
Automatic Pilot	o	
Radar Altimeter	p	
Weather Radar	q	
No Navigation Equipment	r	
ILS RECEIVING EQUIPMENT		
Localizer	s	
Marker Beacon	t	
Glide Slope	u	
Microwave Landing System	v	
No ILS Receiving Equipment	w	

THANK YOU
FOR YOUR COOPERATION

FAA Form 1800—54 (6-77)

FIGURE 1. SURVEY QUESTIONNIARE

2. DEVELOPMENT AND METHODOLOGY

2.1 FLEET SIZE AND REPORT COVERAGE

The 1977 GA aircraft fleet contained 212,598 registered aircraft as of December 31, 1977. The avionics data in this report cover all GA aircraft, but are developed from the results of a 14.4% sample survey of the aircraft (see Appendix A). The survey sample size was 30,643 and achieved a response rate of 78 percent to the avionics questions (see Figure 2).

2.2 PROFILE OF GA AVIONICS

Table 1 summarizes the basic avionics data provided by the 1977 Sample File for the analysis of the 1977 GA fleet. It shows the estimates of the number of aircraft containing each piece of avionics equipment listed on the FAA 1800-54 forms. The usefulness of Table 1 is limited because it does not provide the means to determine the number of aircraft containing important groups of equipment, but deals solely with individual types of equipment. For example, one cannot determine the number of aircraft with all three components of an instrument landing system (ILS): localizer, glide slope, and marker beacon receivers. Thus the capability groups, discussed below, were developed to make the study of groups of avionics equipment possible.

2.3 AVIONICS CAPABILITY GROUPS

2.3.1 Function of Capability Groups

Avionics capability groups (CG's) are the means through which significant groups of avionics equipment are associated with aircraft capability to perform in the NAS. The word "capability" takes on a number of meanings in conjunction with the NAS. It can refer to where an aircraft can fly, at what airports it can land, what type of flying it can do, or to what extent it can participate in the air route, landing, and communications systems. Avionics equipment is installed in an aircraft because of the capabilities gained from it; consequently, one should be able to identify an aircraft's general potential capabilities from knowledge of its avionics

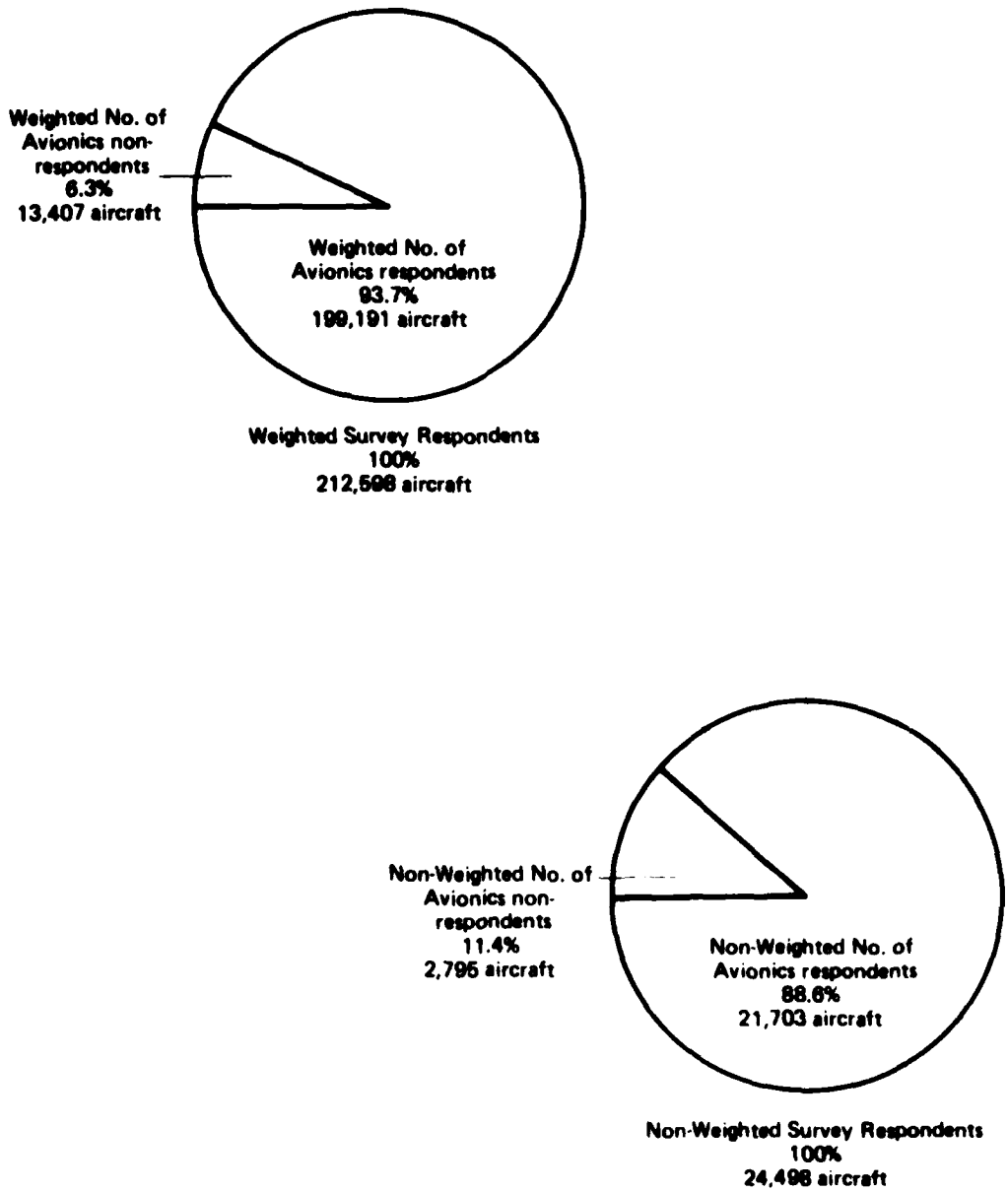


Figure 2. Survey Response to Avionics Questions

TABLE 1. BASIC AVIONICS DATA FOR 1977 GA FLEET*

VHF Communications Equipment	Estimates of Aircraft	% Standard Error
360 channels or less	127,019	A
720 channels or more	54,283	A
2 systems or more	96,125	A
None	37,735	A
Transponder Equipment		
4096 code	108,189	A
Altitude encoding	42,597	A
None	104,405	A
Navigation Equipment		
100 channels VOR receiver	86,556	A
200 channels VOR receiver	82,459	A
More than 1 VOR receiver	97,024	A
Automatic direction finder (ADF)	93,782	A
Distance measuring equipment (DME)	46,597	A
Area navigation equipment (RNAV)	10,424	A
Long range RNAV	1,805	B
Automatic pilot	57,434	A
Radar altimeter	9,878	A
None	48,376	A
Instrument Landing System		
Localizer	99,335	A
Marker beacon	86,372	A
Glide slope	68,011	A
Microwave landing system	688	D
None	107,909	A

*Based on the GA Activity and Avionics Survey for 1977.

STANDARD ERROR		CODE
Greater Than	Less Than or Equal To	
0%	10%	A
10%	20%	B
20%	30%	C
30%		D

equipment configuration. Often several pieces of equipment are required to obtain a certain capability in the NAS; it thus becomes necessary to study groups of avionics, rather than individual pieces. The CG definitions are designed to provide the link between groups of avionics equipment and capabilities. In addition, the CG's provide a framework within which other aspects of the GA fleet can be examined.

2.3.2 Assumptions

Several assumptions must be made in order to simplify the process of designing the groups and to minimize the number of groups needed. First, it is assumed that an aircraft's avionics equipment defines its capability to perform in the NAS. In actuality, an aircraft's engine size and power, pilot's certification, lack of cabin pressurization, or lack of other types of required equipment may prevent the aircraft from performing at its highest capability level according to its avionics configuration. Second, the capability groups are based on regulations and equipment requirements for the majority of general aviation aircraft. There may be exceptions to the avionics needed for certain capabilities depending on the use of the aircraft, the model of the aircraft, and the pilot's skill at maximizing the capabilities that his avionics equipment gives him. Third, it is assumed that area navigation (RNAV) equipment[1] on GA aircraft is comprised of VOR/DME-based course line computers rather than inertial or Doppler systems since as of January 1, 1975, fewer than 0.5 percent of GA aircraft contained the self-contained type of RNAV equipment[2] . Thus, RNAV equipment is considered to comply with FAA requirements for both VOR equipment and distance measuring equipment (DME).

---

1 See the Glossary for definitions of area navigation equipment and other technical terms.

2 Avionics Installation Navigation and Communication Report, FAA/AEM.

2.3.3 Methodology

Two classifications of capability groups evolved: the first type consisted of avionics equipment meeting FAA requirements for use of the various aspects of the NAS; the second type was avionics equipment which gave an aircraft additional capability, but which was not required equipment according to FAA regulations. These two types of equipment necessitated the formation of two types of CG's.

To form the first type of CG, three sets of avionics requirements were obtained: one for flight in different segments of the airspace, another for different types of flying, and the third for landing at different airports. The three sets of requirements were combined into one set of avionics requirements dealing with the above three aspects of the NAS simultaneously. These combined requirements formed the basis for the first type of capability group. They were augmented by miscellaneous requirements for helicopters, air taxis, and gliders.

The formation of the second type of CG was a simpler task. It involved grouping component pieces of avionics equipment which together would form a complete avionics system for enabling an aircraft to make full use of a landing, communications, or navigation system in the NAS. However, except for the instrument landing system (ILS), it was found that an aircraft can gain full use of a system in the NAS by installing only one piece of airborne avionics equipment. Consequently, the second type of CG consists mainly of "groups" containing one piece of equipment each.

2.3.4 Definition of Capability Groups

Definitions of the two types of CG's mentioned above, known as hierarchical and non-hierarchical CG's respectively, are given below in terms of the avionics equipment found in the FAA Survey Form 1800-54. A glossary at the end of this report explains the numerous terms relating to avionics equipment and the NAS found in the definitions below. Appendix D shows the various segments of the airspace and the flying regulations pertaining to the airspace, airports, and type of flying.

2.3.4.1 Hierarchical CG's

The FAA has established airborne avionics equipment requirements for aircraft use of the various segments of the NAS. In this regulatory sense, an aircraft's avionics equipment determines its capabilities to perform in areas of the NAS. FAA regulations deal with three basic capabilities: (1) to fly in different segments of the airspace, (2) to fly under visual flight rules (VFR) and instrument flight rules (IFR) type of flight, and (3) to land at different classes of airports. In the formation of CG's of avionics equipment which relate to these three capabilities, the groups take on a hierarchical nature, that is, there is an order to the groups. In general, the avionics equipment and the associated capabilities for one capability group are a subset of the avionics equipment and the associated capabilities for the next higher group.

These groups have the additional properties that they are mutually exclusive and exhaustive. When assigning individual aircraft to CG's, mutual exclusiveness means that an aircraft can be assigned to only one group. Exhaustiveness means that every aircraft will fall into a group.

Table 2 describes the hierarchical CG's in terms of avionics equipment and capabilities. The capabilities described represent the highest level at which an aircraft has avionics potential to participate in the NAS. Generally an aircraft can also participate at all lower levels. Each group of equipment below is described in terms of (1) airspace capability, (2) type of flying capability, and (3) airport capability. Exceptions to airport and airspace capabilities are noted for helicopter and glider operations respectively.

Figure 3 is a schematic diagram of the hierarchical capability groups, which summarizes the relationship of three types of aircraft capabilities to their required avionics equipment, namely type of flying, airspace, and airport capabilities. In the diagram, the capabilities increase from top to bottom. To determine the capability associated with a particular avionics box, simply position the box relative to the lines of the capability of interest.

TABLE 2. HIERARCHICAL CAPABILITY GROUPS

AVIONICS	CAPABILITIES
Group 1 No regulatory avionics	1. Up to and including 12,500 feet mean sea level (MSL) Gliders...Up to and including 18,000 feet MSL ADF...Colored airways below 12,500 feet MSL VOR or RNAV...VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL 2. VFR flight, day and night 3. Uncontrolled airports
Group 2 Two-way communications	1. Up to and including 12,500 feet MSL Gliders...Up to and including 18,000 feet MSL 2. VFR flight, day and night 3. Non-TCA controlled airports Group III TCA's Helicopters with 4096 code transponders...Group II TCA's All helicopters...Group I and II TCA's below 1,000 feet above ground level (AGL) Note: Air taxis with navigation system and transponder: Group II TCA's Air taxis with navigation system, transponder and altitude reporting: Group I TCA's and non-positive controlled airspace Air taxis with navigation system, DME, transponder and altitude reporting: Group I TCA's and positive controlled airspace.

TABLE 2. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)

AVIONICS	CAPABILITIES
Group 3 Two-way communications Two systems---air taxis VOR or Automatic Direction Finder (ADF) or RNAV	1. Up to and including 12,500 feet MSL Gliders...Up to and including 18,000 feet MSL ADF...Colored airways below 12,500 feet MSL VOR or RNAV...VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL 2. IFR flight 3. Non-TCA controlled airways Group III TCA's Helicopters with 4096 code transponders...Group II TCA's All helicopters...Group I and II TCA's below 1000 feet AGL
Group 4 Two-way communications Two systems---air taxis 4096 code transponder VOR or RNAV	1. Up to and including 12,500 meet MSL Gliders...Up to and including 18,000 feet MSL VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL 2. IFR flight 3. Non-TCA controlled airports Group II TCA's Helicopters...Group I TCA's below 1000 feet AGL
Group 5 4096 code transponder Altitude encoding equipment	1. Non-positive controlled airspace 2. VFR flight, day and night

TABLE 2. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)

AVIONICS	CAPABILITIES
Group 5 (Continued)	3. Uncontrolled airports Group III TCA's
Group 6 Two-way communications 4096 code transponder Altitude encoding equipment	1. Non-positive controlled airspace 2. VFR flight, day and night 3. Non-TCA controlled airports Group III TCA's Helicopters...Group I TCA's
Group 7 Two-way communications Two systems---air taxis 4096 code transponder Altitude encoding equipment VOR	1. Non-positive controlled airspace VOR airways 2. IFR flight 3. Group I TCA's
Group 8 Two-way communications Two systems---air taxis 4096 code transponder Altitude encoding equipment VOR, DME } or RNAV	1. Positive controlled airspace Jet routes RNAV...RNAV routes 2. IFR flight 3. Group I TCA's

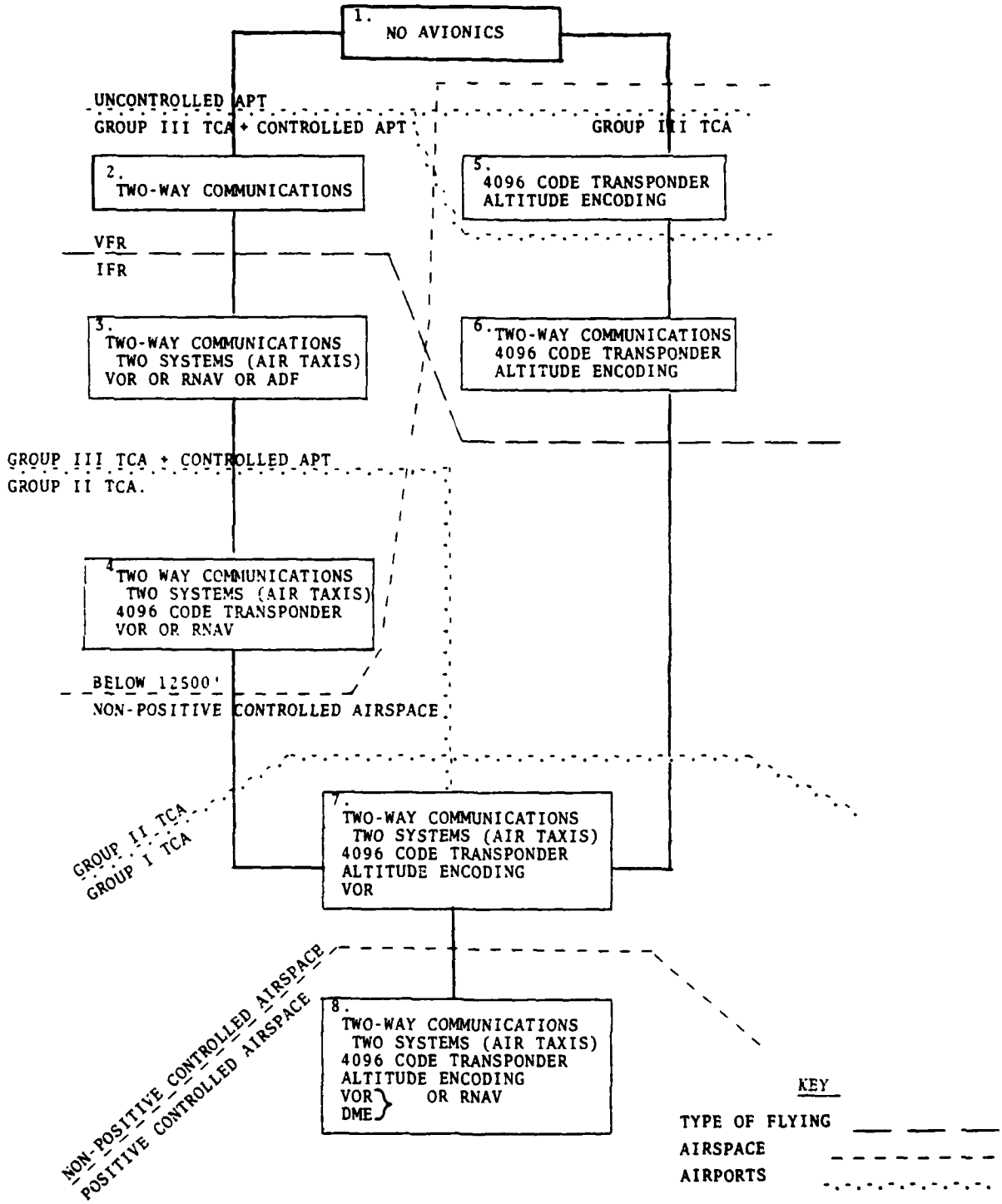


FIGURE 3. HIERARCHICAL CAPABILITY GROUPS (CG'S)

2.3.4.2 Non-Hierarchical CG's

Many kinds of avionics equipment exist which give an aircraft additional capabilities to the three types discussed in the previous section. Whereas the latter capabilities are derived from regulatory considerations, those to be discussed in this section are based on engineering and safety considerations. The avionics CG's of this section have none of the properties of the previous groups. That is, they are not hierarchical in nature, nor are they mutually exclusive and exhaustive. The CG's are described in Table 3 in terms of the avionics equipment and associated capabilities.

2.4 DESCRIPTION OF AIRCRAFT CHARACTERISTICS

Eight aircraft characteristics were available on the 1977 Sample File for analysis in the framework of the CG's. They are listed below with appropriate comment.

a. Primary use of aircraft during 1977.

b. Hours flown during 1977: This variable was discretized into 50-hour intervals for easier reporting.

c. Age of aircraft in 1977: This variable was discretized into 5-year intervals for easier reporting.

d. Computed aircraft type: The 13 computed aircraft types listed in Table 4 combine the four aircraft characteristics of engine type, number of engines, aircraft type (simple), and number of seats into meaningful combinations for the GA fleet.

e. Aircraft type (simple).

f. Engine type.

g. Number of engines.

h. Number of seats.

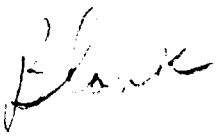
TABLE 3. NON-HIERARCHICAL CAPABILITY GROUPS

AVIONICS	CAPABILITIES
Group 1 Localizer	Partial use of airport ILS
Group 2 Localizer Marker Beacon	Partial use of airport ILS
Group 3 Localizer Marker Beacon Glide Slope	Full use of airport ILS
Group 4 ILS Radar Altimeter	Landing approach in Category III[1] weather conditions at airports with Category III equipment
Group 5 Long Range RNAV	Area navigation over long distances and large bodies of water
Group 6 Radar Altimeter	Determination of altitude above level of terrain
Group 7 Microwave Landing System (MLS)	More accurate and flexible landing approaches especially at airports with mountains and large buildings nearby
Group 8 ILS Microwave Landing System (MLS)	Backup landing systems
Group 9 Long Range RNAV Microwave Landing System (MLS)	Sophisticated navigational and landing capabilities

[1]See Appendix D, "Weather Category Definitions."

TABLE 4. COMPUTED AIRCRAFT TYPE

TYPE	DESCRIPTION
1.	Fixed wing single engine piston 1-3 seats
2.	Fixed wing single engine piston 4+ seats
3.	Fixed wing two engine piston 1-6 seats
4.	Fixed wing two engine piston 7+ seats
5.	Fixed wing piston other
6.	Fixed wing two engine turboprop 1-12 seats
7.	Fixed wing two engine turboprop 13+ seats
8.	Fixed wing turboprop other
9.	Fixed wing two engine turbojet
10.	Fixed wing turbojet other
11.	Rotorcraft piston
12.	Rotorcraft turbine
13.	Other aircraft



3. RESULTS

3.1 NON-HIERARCHICAL VERSUS HIERARCHICAL CAPABILITY GROUPS (CG's)

Table 5 presents the estimates of the number of GA aircraft found in the hierarchical and non-hierarchical CG's. Hierarchical CG's vary across the columns and non-hierarchical CG's vary across the rows, each beginning with the least sophisticated CG in the upper left hand corner of the table. Entries in the table are composed of four lines: aircraft estimates, standard error, percent of the row or non-hierarchical capability that estimate represents, and percent of column or hierarchical capability that estimate represents.

Examination of Table 5 reveals the following observations on the GA fleet.

3.1.1 Hierarchical CG's

a. About 16 percent of GA aircraft have the avionics equipment enabling them to fly above 18,000 feet in positive controlled airspace. Approximately 80 percent of the GA fleet cannot fly above 12,500 feet due to avionics limitations alone.

b. Almost 76 percent of GA aircraft are equipped to fly IFR.

c. About 18 percent of the GA fleet are limited to landing at uncontrolled airports. Approximately 32 percent can land at either uncontrolled airports or Group III TCA's. Approximately 30 percent can land at any type of airport except a Group I TCA. Only about 20 percent can land at Group I TCA's.

d. Hierarchical CG's 5 and 6 together contain only 0.4 percent of the GA fleet. Examination of the avionics equipment associated with these groups reveals that both include transponder equipment, but neither includes navigation equipment. One

TABLE 5. NON-HIERARCHICAL VS. HIERARCHICAL CAPABILITY GROUPS

1977

		1	2	3	4	5	6	7	8	TOTALS
L	ESTIMATE	123	377	8300	7943	0	2	1016	371	18132
	% STD ERR	35.1	37.0	14.0	15.6	0.0	*	*	*	9.5
	ROW %	0.7	2.1	45.8	43.8	0.0	0.0	5.6	2.0	
	COLUMN %	0.3	2.7	15.1	12.5	0.0	0.3	11.6	1.1	8.5
L,MB	ESTIMATE	20	111	1883	12070	113	225	1304	323	16050
	% STD ERR	*	*	23.1	11.2	*	*	39.8	38.8	9.2
	ROW %	0.1	0.7	11.7	75.2	0.7	1.4	8.1	2.0	
	COLUMN %	0.1	0.8	3.4	19.0	77.4	38.6	14.9	1.0	7.5
L,MB,GS	ESTIMATE	232	94	981	25475	15	185	5123	23473	55577
	% STD ERR	*	45.1	27.7	6.8	45.5	43.7	14.1	4.7	3.3
	ROW %	0.4	0.2	1.8	45.8	0.0	0.3	9.2	42.2	
	COLUMN %	0.6	0.7	1.8	40.0	10.3	31.7	58.6	70.9	26.1
L,MB,GS,RA	ESTIMATE	5	6	16	491	0	79	104	8875	9576
	% STD ERR	*	*	44.7	29.6	0.0	40.4	42.7	6.5	6.2
	ROW %	0.1	0.1	0.2	5.1	0.0	0.8	1.1	92.7	
	COLUMN %	0.0	0.0	0.0	0.8	0.0	13.6	1.2	26.8	4.5
LRN	ESTIMATE	0	13	84	395	0	0	47	1263	1806
	% STD ERR	0.0	*	41.9	41.8	0.0	0.0	*	9.7	11.7
	ROW %	0.0	0.7	4.7	22.1	0.0	0.0	2.6	69.9	
	COLUMN %	0.0	0.1	0.2	0.6	0.0	0.0	0.5	3.8	0.8
RA	ESTIMATE	6	6	56	644	0	80	133	8954	9878
	% STD ERR	*	*	41.9	28.5	0.0	39.9	35.1	6.5	6.1
	ROW %	0.1	0.1	0.6	6.5	0.0	0.8	1.3	90.6	
	COLUMN %	0.0	0.0	0.1	1.0	0.0	13.7	1.5	27.0	4.6
PL	ESTIMATE	24	0	9	182	1	0	16	456	689
	% STD ERR	*	0.0	*	*	*	0.0	40.5	*	38.7
	ROW %	3.5	0.0	1.3	26.4	0.1	0.0	2.3	66.2	
	COLUMN %	0.1	0.0	0.0	0.3	0.7	0.0	0.2	1.4	0.3
L,PB,GS,ML	ESTIMATE	1	0	4	150	0	0	15	456	626
	% STD ERR	*	0.0	46.7	*	0.0	0.0	41.8	*	42.2
	ROW %	0.2	0.0	0.6	24.0	0.0	0.0	2.4	72.8	
	COLUMN %	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.4	0.3

TABLE 5. NON-HIERARCHICAL VS. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)
1977

		1	2	3	4	5	6	7	8	TOTALS
LRN,ML	ESTIMATE	0	0	0	106	0	0	0	57	163
	% STD ERR	0.0	0.0	0.0	*	0.0	0.0	0.0	*	*
	ROW %	0.0	0.0	0.0	65.0	0.0	0.0	0.0	35.0	
	COLUMN %	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.1
NC GROUP	ESTIMATE	37185	13253	43701	17575	17	90	1195	42	113862
	% STD ERR	2.5	7.0	4.7	9.8	*	41.2	38.4	*	1.9
	ROW %	32.9	11.7	38.7	15.5	0.0	0.1	1.1	0.0	
	COLUMN %	98.9	95.7	79.6	27.6	11.6	15.4	13.7	0.1	53.2
ALL CRAFT	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	1.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 5. NON-HIERARCHICAL VS. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)

KEY

Hierarchical Capability Groups

1. No regulatory avionics[1]
2. Two-way communications
3. Two-way communications
   Two systems - air taxis
   VOR or ADF or RNAV
4. Two-way communications
   Two systems - air taxis
   4096 code transponder
   VOR or RNAV
5. 4096 code transponder
   Altitude encoding equipment
6. Two-way communications
   4096 code transponder
   Altitude encoding equipment
7. Two-way communications
   Two systems - air taxis
   4096 code transponder
   Altitude encoding equipment
   VOR
8. Two-way communications
   Two systems - air taxis
   4096 code transponder
   Altitude encoding equipment
   VOR } or RNAV
   DME }

Non-hierarchical Capability Groups[2]

LOC: Localizer
MB: Marker beacon
GS: Glide slope
MLS: Microwave landing system
RA: Radar altimeter
LRN: Long range RNAV
NO GROUPS: Non-grouped aircraft[3]

[1]Aircraft assigned to hierarchical CG 1 (No regulatory avionics) contain either no avionics equipment whatsoever or a combination of equipment which does not match or exceed the specified requirements for any other hierarchical CG.

[2]Since non-hierarchical groups are not all mutually exclusive (they overlap), the columns do not add to the counts at the bottom of the table. The first four groups (LOC through MLS) are mutually exclusive among themselves. However there is some overlap between the first four groups and the next five groups. The last group is mutually exclusive of the other nine.

[3]Non grouped aircraft (NG) are those aircraft possessing none of the avionics covered by the other nine non hierarchical CG's.

includes two-way communications. This suggests that the reason for the small number of aircraft in these groups and the comparatively large number in the remaining groups is that the most common path of acquisition of avionics equipment proceeds from communications to navigation to transponder equipment.

A comparison of hierarchical CG's from 1974, 1975, 1976, and 1977 reveals that significant changes occurred in two of the basic capabilities: airspace and airport. Growth occurred in the capability of flying above 18,000 feet (CG 8) in positive controlled airspace and the capability of landing at Group I TCA's (CG's 7 and 8). This indicates a general increase in avionics sophistication over the four year period. Figures 4, 5, 6, and 7 illustrate the changes which occurred in these two basic capabilities.

Figures 4 and 6 present the percentages of the fleet within the subdivisions of the airspace and airport capabilities, respectively. Those subdivisions requiring more sophisticated avionics increased while those requiring less sophistication decreased.

Figures 5 and 7 present normalized[1] growth of the capabilities from 1974 to 1977 relative to growth of the fleet as a whole. Normalization allows one to observe clearly changes in group sizes which are significant in relation to changes in the overall fleet. Figure 5 shows that the proportion of the fleet capable of flying above 18,000 feet grew much more rapidly than the fleet. In contrast growth of planes flying below 12,500 feet (CG's 1-4) lagged behind growth of the fleet as a whole. **Figure** 7 shows that growth in the proportion of the fleet capable of landing at Group I TCA's was much larger than overall fleet growth.

In general Table 5 indicates that those aircraft in the least sophisticated non-hierarchical CG's also comprise the

[1] Each group is normalized by the following formula: [(percent aircraft in 1977) - (percent aircraft in 1974)] ÷ (percent aircraft in 1974).

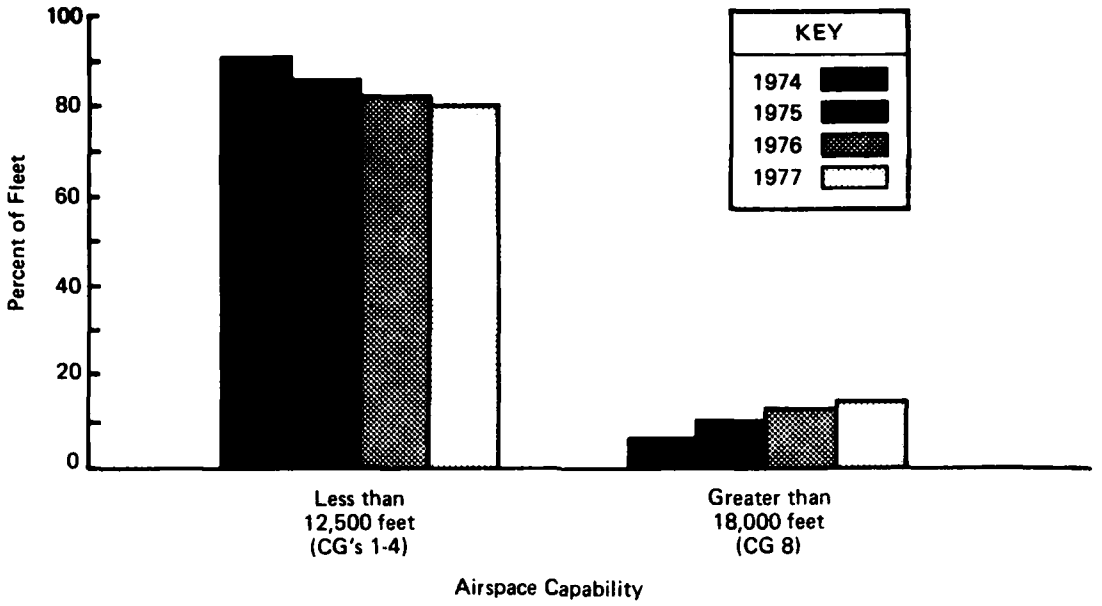


Figure 4. A Comparison of Airspace Capabilities for 1974, 1975, 1976, and 1977

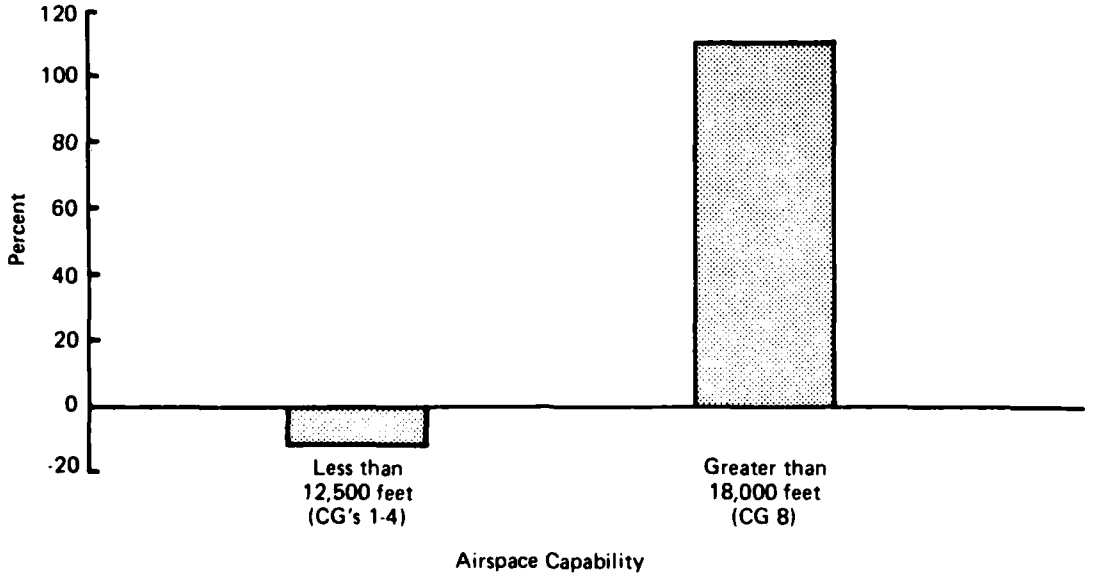


Figure 5. Normalized Growth in Airspace Capabilities from 1974 to 1977

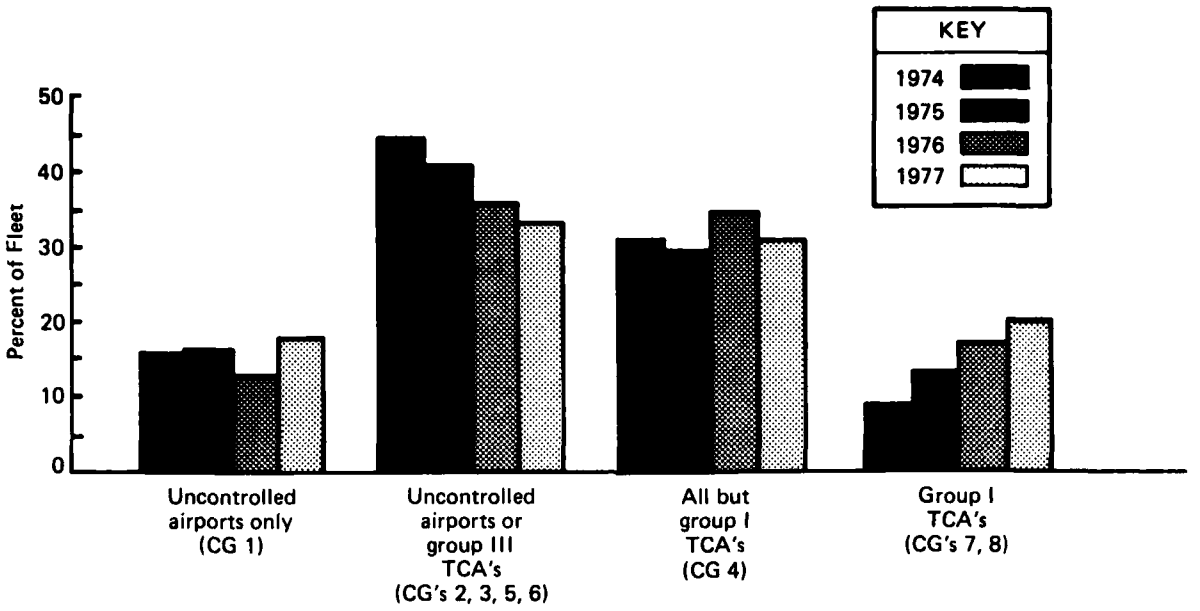


Figure 6. A Comparison of Airport Capabilities for 1974, 1975, 1976, and 1977

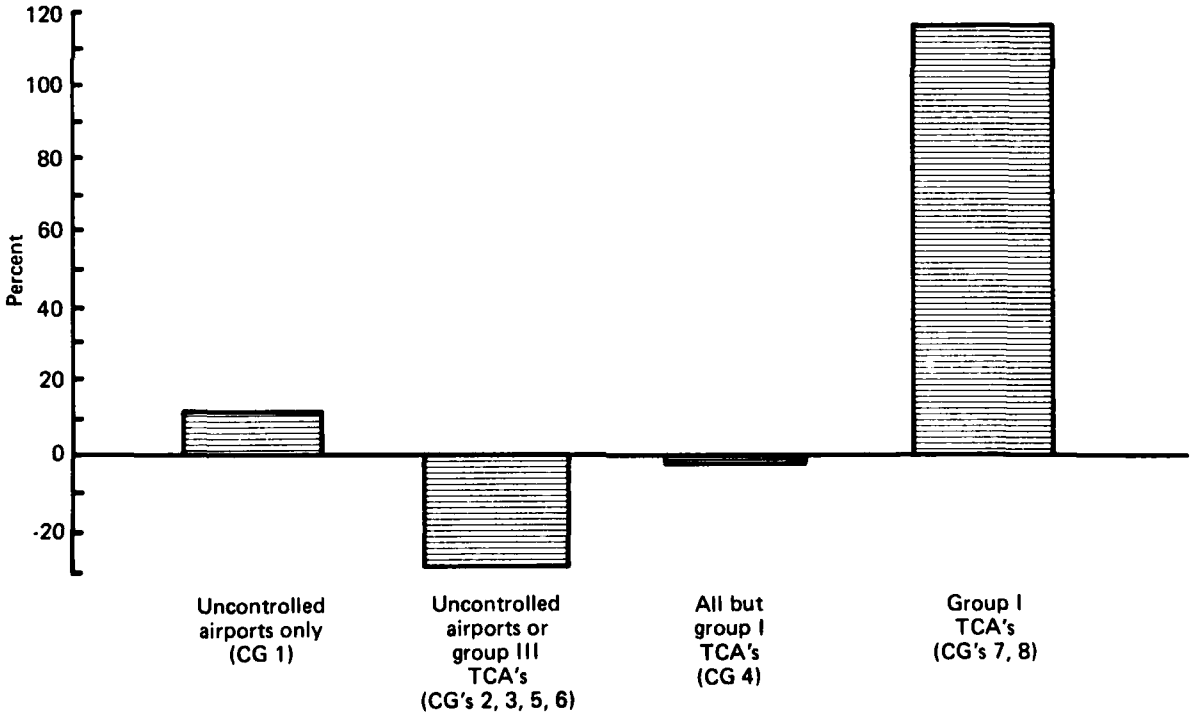


Figure 7. Normalized Growth in Airport Capabilities from 1974 to 1977

bulk of the least sophisticated hierarchical CG's. Of the aircraft possessing none of the non-hierarchical CG equipment (i.e., NO GROUP), 83 percent fall into hierarchical CG's 1, 2, and 3. Similarly, those aircraft in the most sophisticated non-hierarchical CG's are also in the most sophisticated hierarchical CG's. For example, 93 percent of the aircraft possessing a complete ILS and a radar altimeter fall into hierarchical CG 8.

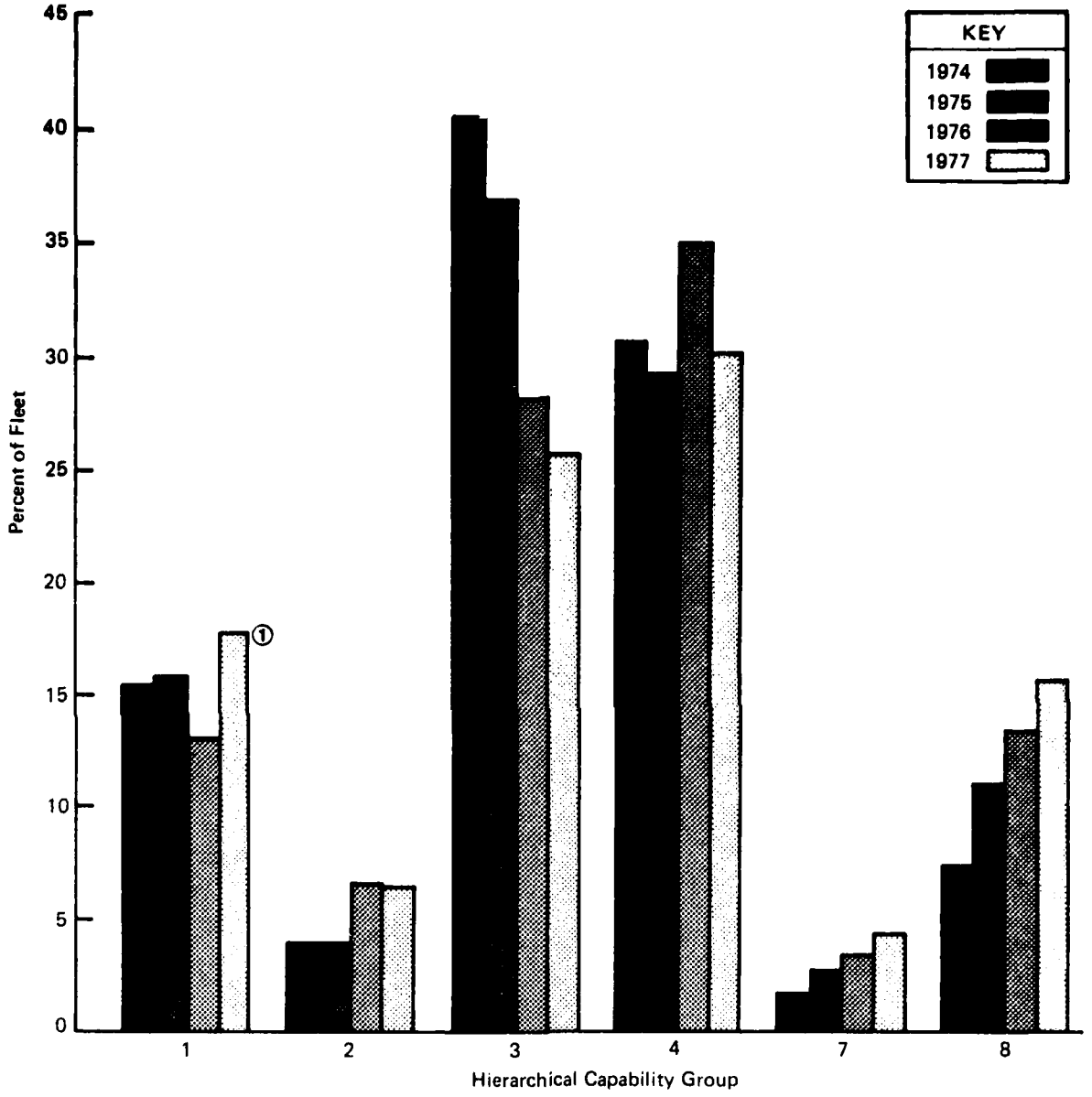
Figures 8 and 9 illustrate the changes which occurred to the hierarchical CG's from 1974 to 1977. Figure 8 provides a comparison of the major hierarchical CG percentages over the four year period and also enables one to gauge the group sizes relative to each other. It is evident that groups 3 and 4 comprise more than half the GA fleet, but that groups 7 and 8 are gaining in importance.

Figure 9 presents the normalized growth of the CG's relative to the growth of the fleet as a whole from 1974 to 1975, and from 1975 to 1976, and from 1976 to 1977. A study of Figure 9 reveals that CG's 1, 7, and 8 grew faster than the overall fleet.

The excessive growth exhibited by CG 1 is probably artificial due to the much higher percentage of respondents in 1977 than 1976. It is most likely that many owners of aircraft with no avionics equipment did not respond to the 1976 survey, while in 1977 the telephone survey of non-respondents reached these owners. Thus the increase in respondents caused a disproportionate increase in CG 1. Growth in CG's 7 and 8 indicates a general trend toward greater sophistication in avionics.

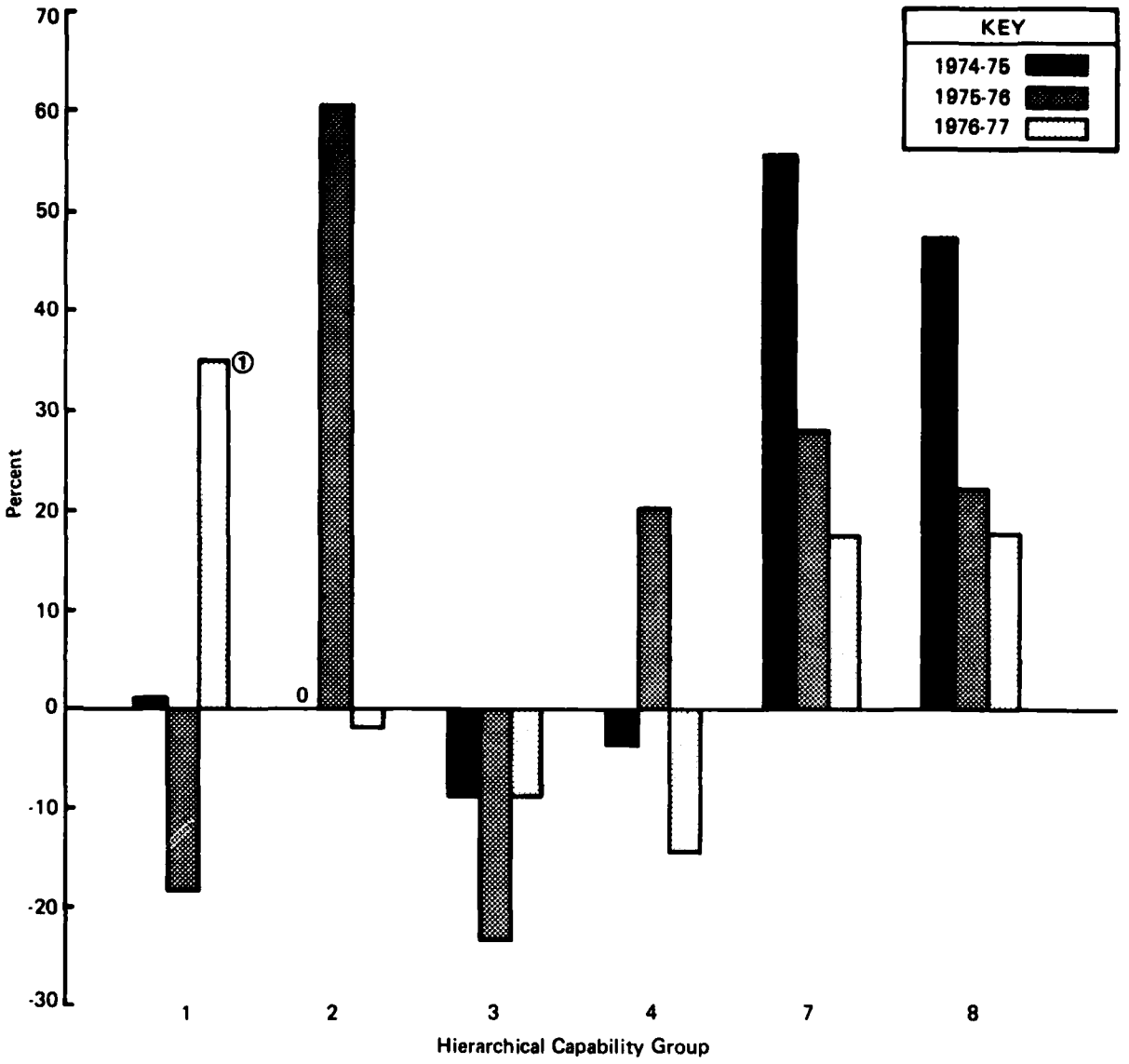
3.1.2 Non-Hierarchical CG's

Because the non-hierarchical capability groups were revised in 1976, comparison with previous years can be done only for the groups L; L, MB; and L, MB, GS. Figures 10 and 11 illustrate the changes from 1974 to 1977 in these three CG's. Figure 12 illustrates the change from 1976 to 1977 in the remaining non-hierarchical capability groups. A study of Figures 10 and 11 shows a decrease in all ILS groups. However, the decrease shown by the L, MB, GS, and RA group is probably artificial due to the higher percentage of respondents in 1977 than 1976 as mentioned above. The number is probably increasing, but the proportion of the fleet appears to be decreasing because the less well-equipped aircraft are accounting for a larger portion of the respondents than before.



① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 8. A Comparison of Hierarchical CG's from 1974 to 1977



① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 9. Normalized Growth in Hierarchical Group Size from 1974 to 1975, 1975 to 1976, and 1976 to 1977

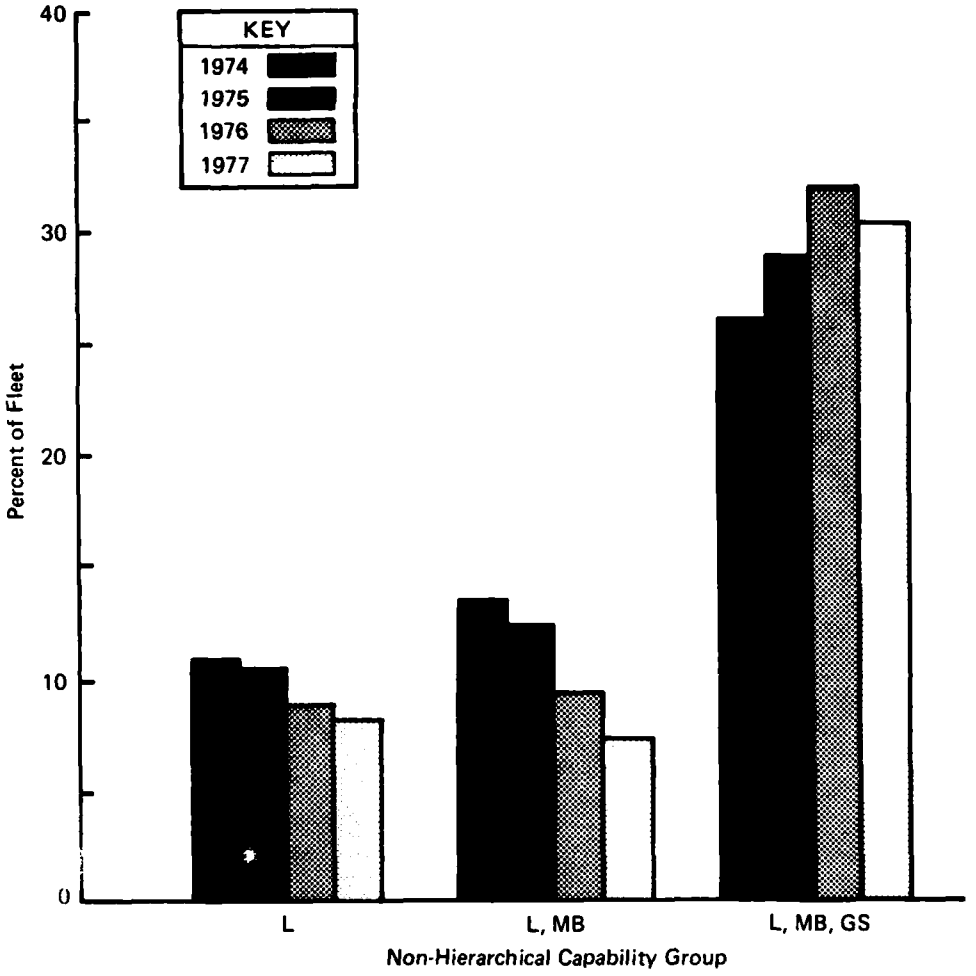


Figure 10. A Comparison of Non-Hierarchical Groups from 1974 to 1977

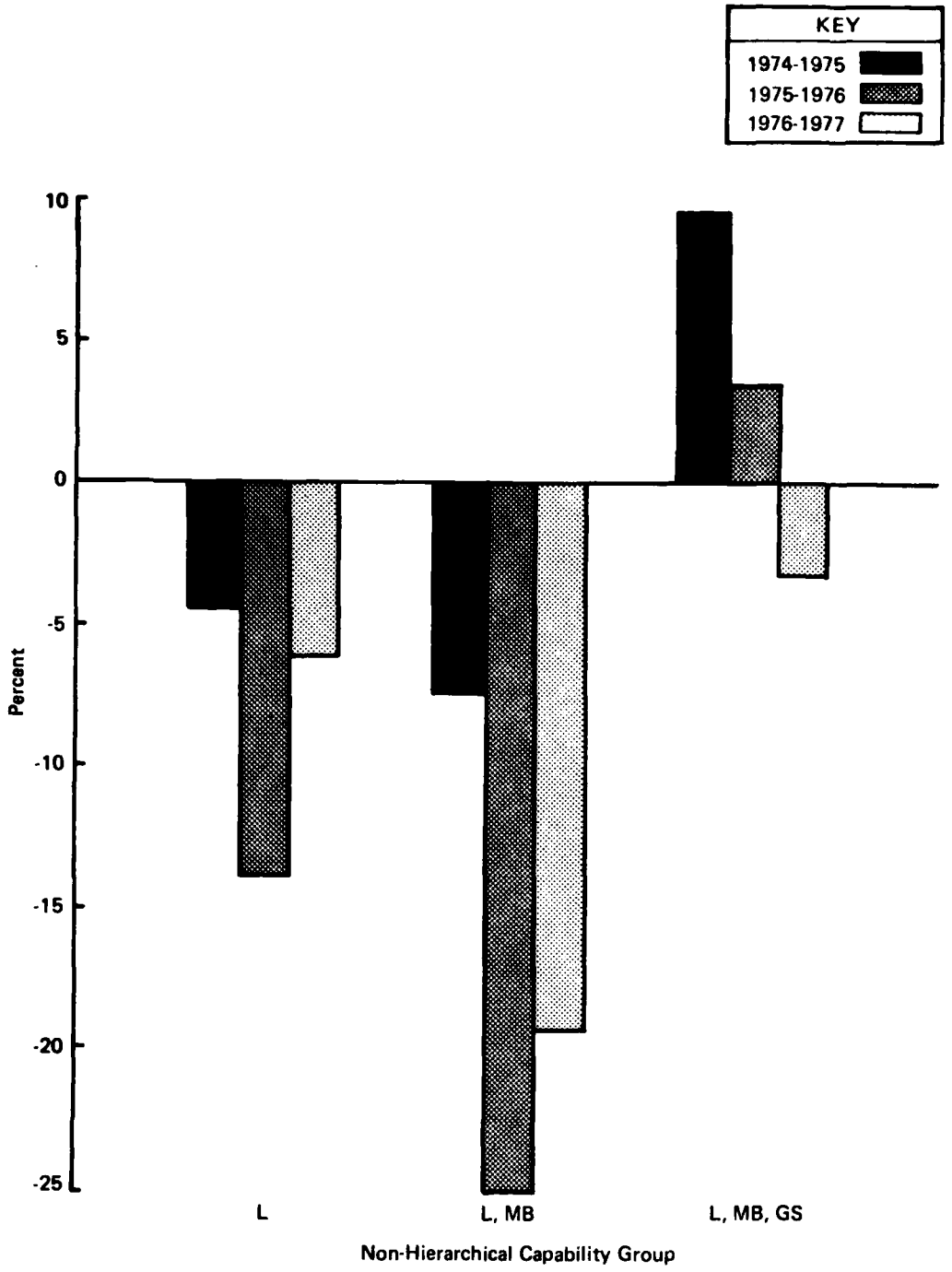


Figure 11. Normalized Growth in Non-Hierarchical Groups from 1974 to 1975, 1975 to 1976, and 1976 to 1977

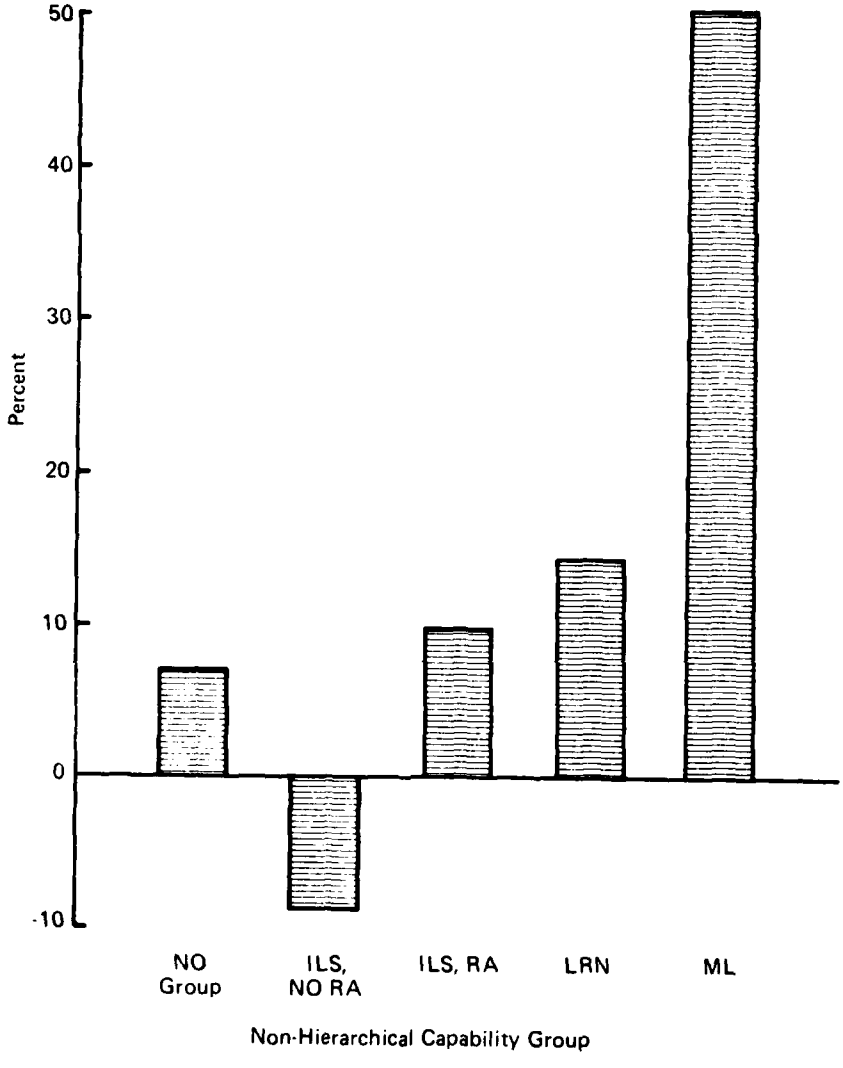


Figure 12. Normalized Growth in Non-Hierarchical Groups from 1976 to 1977

3.2 CHARACTERISTICS OF CAPABILITY GROUPS (CG'S)

Tables 6 through 21 show four numbers in each cell. The first is the number of aircraft falling into the particular capability group-category combination represented by the cell. The second is the percent standard error. The third number is the percent of the row or category that the number of aircraft represents. The fourth number is the percent of the column or capability group that the number of aircraft represents.

The key appearing at the bottom of each table gives the avionics associated with the CG's. Hierarchical group reports are additive across the columns as these groups are mutually exclusive. The numbers in the right-hand columns of the non-hierarchical group reports are the marginal distributions of the GA fleet across the categories, but are not row totals since non-hierarchical CG's are not mutually exclusive.

3.2.1 Characteristics of Hierarchical CG's

As mentioned in the discussion of Table 5, there was significant growth in hierarchical CG's 7 and 8 from 1976 to 1977 attributable to both upgrading avionics systems in pre-1977 aircraft and installing complex avionics equipment in new aircraft. Tables 6 through 13 and Figures 13 through 18 show the kinds of aircraft exhibiting these changes and present other characteristics of the GA fleet.

Generally, those aircraft in low order CG's have less sophisticated characteristics than those aircraft in high order CG's as follows:

a. As the hierarchical CG's increase in sophistication, the predominant uses also grow in sophistication from personal, to business and personal, to executive, business and personal (Table 6, Figures 13 and 14).

b. Aircraft containing more avionics equipment and capabilities are flown more hours than those with smaller investments in avionics equipment (Table 7, Figure 15).

c. High order CG's contain newer aircraft on the average than low order CG's (Table 8, Figure 16).

d. As in a. above, the computed aircraft type, as well as the four individual characteristics which are combined to form computed aircraft type (simple aircraft type, engine type, number of engines, number of seats), become progressively more sophisticated moving from low to high order CG's (Tables 9 through 13, Figures 17 and 18).

A comparison of the 1977 tables with the 1976 tables reveals the following characteristics of the aircraft responsible for the growth in hierarchical CG's 1, 7, and 8.

a. The changes in primary uses of aircraft in CG's 1, 7, and 8 were not significant (Table 6).

b. The aircraft not flown or flown fewer than 150 hours increased in CG's 1 and 7 (Table 7).

c. The largest growth in CG 8 was exhibited by planes in the 0 to 4 year age category, indicating that new planes are being more fully equipped with avionics than at any time in the past. CG 8 contained 23 percent of the planes from 0 to 4 years old in 1976. In 1977 this number increased to 28 percent (Table 8).

d. The main aircraft types shifting into CG's 7 and 8 are fixed wing twin engine piston aircraft with 1-6 seats and 7 or more seats. For example, in 1976, 54 and 62 percent, respectively of these two types fell into CG 8; in 1977, 67 and 63 percent fell into CG 8. Other aircraft types exhibited little or no changes (Table 9).

3.2.2 Characteristics of Non-Hierarchical CG's

In the discussion of Table 5 it was noted that the non-hierarchical groups containing complete ILS changed substantially from 1976 to 1977. Tables 14 through 21 and Figures 19 through 22 help to identify which kinds of GA aircraft installed these avionics systems during 1977, and to characterize in general the kinds of GA aircraft equipped with these avionics.

Tables 14 through 21 show that sophisticated aircraft in terms of characteristics such as primary use, aircraft type, flying hours, etc., are more likely to possess advanced avionics systems than the simpler aircraft in the GA fleet as follows:

a. As non-hierarchical CG's increase in sophistication, the predominant primary uses of aircraft change from personal and business, to personal, business and executive, to business and executive. For example, executive aircraft alone compose about 45 percent of the aircraft reporting both a complete ILS and a radar altimeter and over 47 percent of the aircraft reporting a long range RNAV, yet executive aircraft compose only 4.2 percent of the fleet (Table 14 and Figure 19).

b. Aircraft containing more avionics equipment and capabilities fly more hours than aircraft with smaller investments in avionics equipment (Table 15 and Figure 20).

c. Aircraft falling into the non-grouped category are older than those falling into the other non-hierarchical CG's. Within the latter groups, age decreases as the level of avionics increases (Table 16 and Figure 21).

d. Computed aircraft type increases in sophistication as the level of avionics increases. This direct relationship also holds for the following four characteristics which are combined to form computed aircraft type: simple aircraft type, engine type, number of engines, and number of seats (Tables 17 through 21 and Figure 22).

Comparing Tables 14 through 21 with the equivalent tables from 1976 identifies the characteristics of aircraft which acquired new avionics equipment during 1977 as follows:

a. Business and personal use aircraft accounted for the increase in MLS's in 1977. Other primary use categories showed smaller increases in the proportion of MLS's (Table 14). However, the increase is probably not as significant as shown in

Figure 19 because a large standard error was associated with those figures and the proportion of aircraft surveyed containing MLS's is quite small (Table 14).

b. Increases in MLS's were evident in almost all hours flown categories. The increase shown in Figure 20 may be due to the large standard error associated with those figures and the fact that the proportion of aircraft surveyed containing MLS's is very small (Table 15).

c. Addition of MLS's was evident in 5-9 year age categories. Other age categories showed insignificant increases in the proportion of MLS's. However, the increase shown in Figure 21 is probably exaggerated by the effect of sampling error. (Table 16).

TABLE 6. HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
EXECUTIVE	ESTIMATE	41	73	269	812	0	48	165	7516	8924
	% STD ERR	*	*	39.1	26.0	0.0	*	35.5	5.1	5.1
	ROW %	0.5	0.8	3.0	9.1	0.0	0.5	1.8	84.2	
	COLUMN %	0.1	0.5	0.5	1.3	0.0	8.2	1.9	22.7	4.2
BUSINESS	ESTIMATE	1111	629	5697	18019	2	62	2418	13875	41811
	% STD ERR	18.3	24.2	17.6	8.2	*	*	24.2	6.6	4.6
	ROW %	2.7	1.5	13.6	43.1	0.0	0.1	5.8	33.2	
	COLUMN %	3.0	4.5	10.4	28.3	1.4	10.6	27.6	41.9	19.7
PERSONAL	ESTIMATE	12687	5289	34606	27945	119	1	4435	5268	90351
	% STD ERR	6.0	9.3	6.0	7.0	*	*	20.8	12.9	2.7
	ROW %	14.0	5.9	38.3	30.9	0.1	0.0	4.9	5.8	
	COLUMN %	33.8	38.2	63.0	43.9	81.5	0.2	50.7	15.9	42.5
AERIAL AP.	ESTIMATE	5802	1033	377	307	4	0	67	17	7606
	% STD ERR	5.1	20.8	28.4	30.4	*	0.0	32.8	*	4.1
	ROW %	76.3	13.6	5.0	4.0	0.1	0.0	0.9	0.2	
	COLUMN %	15.4	7.5	0.7	0.5	2.7	0.0	0.8	0.1	3.6
INSTRUCT.	ESTIMATE	578	1599	5512	6723	0	0	305	1424	16141
	% STD ERR	17.4	44.5	20.8	18.0	0.0	0.0	*	30.3	10.6
	ROW %	3.6	9.9	34.1	41.7	0.0	0.0	1.9	8.8	
	COLUMN %	1.5	11.5	10.0	10.6	0.0	0.0	3.5	4.3	7.6
AIR TAXI	ESTIMATE	47	1366	425	1693	0	461	434	2542	6969
	% STD ERR	*	17.5	31.2	16.7	0.0	25.3	29.6	12.1	7.3
	ROW %	0.7	19.6	6.1	24.3	0.0	6.6	6.2	36.5	
	COLUMN %	0.1	9.9	0.8	2.7	0.0	79.1	5.0	7.7	3.3
INDUSTR SP'	ESTIMATE	29	256	351	468	0	0	134	140	1378
	% STD ERR	*	31.3	27.3	39.8	0.0	0.0	*	40.8	17.7
	ROW %	2.1	18.6	25.5	34.0	0.0	0.0	9.7	10.2	
	COLUMN %	0.1	1.8	0.6	0.7	0.0	0.0	1.5	0.4	0.6
RENTAL	ESTIMATE	621	302	951	5068	0	0	567	1287	8796
	% STD ERR	29.1	28.5	48.3	23.1	0.0	0.0	40.1	29.1	15.1
	ROW %	7.1	3.4	10.8	57.6	0.0	0.0	6.4	14.6	
	COLUMN %	1.7	2.2	1.7	8.0	0.0	0.0	6.5	3.9	4.1

TABLE 6. HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP (CONTINUED)

1977

		1	2	3	4	5	6	7	8	TOTALS
OTHER	ESTIMATE	1287	872	1052	792	2	14	160	885	5064
	% STD ERR	20.3	19.5	37.4	22.0	44.3	41.7	43.0	18.5	11.0
	ROW %	25.4	17.2	20.8	15.6	0.0	0.3	3.2	17.5	
	COLUMN %	3.4	6.3	1.9	1.2	1.4	2.4	1.8	2.7	2.4
INACTIVE	ESTIMATE	15393	2444	5834	1353	21	7	222	280	25554
	% STD ERR	4.0	10.9	12.2	20.2	*	*	48.2	40.7	3.9
	ROW %	60.2	9.6	22.8	5.3	0.1	0.0	0.9	1.1	
	COLUMN %	41.0	17.6	10.6	2.1	14.4	1.2	2.5	0.8	12.0
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

KEY

GROUP
1. NO REGULATORY AVIONICS
2. TWO-WAY COMMUNICATIONS
3. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
VOR OR RNAV
5. 4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT
6. TWO-WAY COMMUNICATIONS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

GROUP
7. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT
8. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
ALTITUDE ENCODING EQUIPMENT
4096 CODE TRANSPONDER
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NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 7. HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
1-49	ESTIMATE	9927	3496	15952	9612	7	11	1092	1885	41982
	% STD ERR	5.7	8.9	9.2	11.8	*	47.1	38.6	24.5	4.7
	ROW %	23.6	8.3	38.0	22.9	0.0	0.0	2.6	4.5	
	COLUMN %	26.4	25.2	29.0	15.1	4.8	1.9	12.5	5.7	19.7
50-99	ESTIMATE	4386	2172	13562	12541	112	30	2084	3714	38601
	% STD ERR	13.8	19.3	10.8	11.1	*	*	33.4	14.4	5.5
	ROW %	11.4	5.6	35.1	32.5	0.3	0.1	5.4	9.6	
	COLUMN %	11.7	15.7	24.7	19.7	76.7	5.1	23.8	11.2	18.2
100-149	ESTIMATE	1867	1087	6954	11140	2	15	1889	4515	27389
	% STD ERR	13.1	13.9	15.5	11.6	*	*	30.2	12.8	6.6
	ROW %	6.8	3.7	25.4	40.7	0.0	0.1	6.9	16.5	
	COLUMN %	5.0	7.3	12.7	17.5	1.4	2.6	21.6	13.6	12.9
150-199	ESTIMATE	1461	588	3371	7608	0	16	647	3335	17025
	% STD ERR	19.9	22.9	23.0	16.0	0.0	*	36.2	14.1	9.0
	ROW %	8.6	3.5	19.8	44.7	0.0	0.1	3.8	19.6	
	COLUMN %	3.9	4.2	6.1	12.0	0.0	2.7	7.4	10.1	8.8
200-249	ESTIMATE	1012	298	2859	5866	2	31	1031	3833	14931
	% STD ERR	22.0	40.4	27.4	15.9	*	*	25.4	11.8	8.8
	ROW %	6.8	2.0	19.1	39.3	0.0	0.2	6.9	25.7	
	COLUMN %	2.7	2.2	5.2	9.2	1.4	5.3	11.8	11.6	7.0
250-299	ESTIMATE	554	316	1082	1757	4	63	219	2704	6738
	% STD ERR	28.0	36.8	42.0	27.0	*	*	*	16.6	12.2
	ROW %	8.8	4.7	16.1	26.1	0.1	0.9	3.3	40.1	
	COLUMN %	1.6	2.3	2.0	2.8	2.7	10.8	2.5	8.2	3.2
300-349	ESTIMATE	580	383	1331	3477	0	2	386	3507	9665
	% STD ERR	23.0	32.4	38.9	26.3	0.0	*	*	12.3	12.0
	ROW %	6.0	4.0	13.8	36.0	0.0	0.0	4.0	36.3	
	COLUMN %	1.5	2.8	2.4	5.5	0.0	0.3	4.4	10.6	4.5
350-399	ESTIMATE	935	276	734	2370	0	25	205	1230	5775
	% STD ERR	26.7	36.6	*	30.8	0.0	*	*	17.1	16.0
	ROW %	16.2	4.8	12.7	41.0	0.0	0.4	3.5	21.3	
	COLUMN %	2.5	2.0	1.3	3.7	0.0	4.3	2.3	3.7	2.7

TABLE 7. HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP (CONTINUED)

1977

		1	2	3	4	5	6	7	8	TOTALS
400-449	ESTIMATE	215	1384	872	1076	0	16	503	1833	5908
	% STD ERR	46.4	*	*	41.1	0.0	*	*	18.0	18.0
	ROW %	3.6	23.5	14.8	18.2	0.0	0.3	8.5	31.1	
	COLUMN %	0.6	10.0	1.6	1.7	0.0	2.7	5.8	5.5	2.8
450 UP	ESTIMATE	1227	1501	2524	6373	0	376	625	6409	19035
	% STD ERR	19.7	17.8	31.0	17.3	0.0	34.0	27.6	8.8	7.7
	ROW %	6.4	7.9	13.3	33.5	0.0	2.0	3.3	33.7	
	COLUMN %	3.3	10.8	4.6	10.0	0.0	64.5	7.1	19.4	9.0
INACTIVE	ESTIMATE	15393	2444	5834	1353	21	7	222	280	25554
	% STD ERR	4.0	10.9	12.2	20.2	*	*	48.2	48.7	3.9
	ROW %	60.2	9.6	22.8	5.3	0.1	0.0	0.9	1.1	
	COLUMN %	41.0	17.6	10.6	2.1	14.4	1.2	2.5	0.8	12.0
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

KEY

GROUP
1. NO REGULATORY AVIONICS
2. TWO-WAY COMMUNICATIONS
3. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   VOR OR RNAV
5. 4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
6. TWO-WAY COMMUNICATIONS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT

GROUP
7. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
8. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   ALTITUDE ENCODING EQUIPMENT
   4096 CODE TRANSPONDER
   VOR } OR RNAV
   DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 8. HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
0-4 YRS	ESTIMATE	6975	4430	9398	16865	6	52	2591	15378	55695
	% STD ERR	6.2	18.7	14.7	10.3	*	*	20.8	6.2	4.1
	ROW %	12.5	8.0	16.9	30.3	0.0	0.1	4.7	27.6	
	COLUMN %	18.6	32.0	17.1	26.5	4.1	8.9	29.6	46.4	26.2
5-9 YRS	ESTIMATE	4845	1949	6734	15339	0	87	1317	6943	37214
	% STD ERR	10.5	13.4	16.2	11.1	0.0	*	34.6	9.2	5.7
	ROW %	13.0	5.2	18.1	41.2	0.0	0.2	3.5	18.7	
	COLUMN %	12.9	14.1	12.3	24.1	0.0	14.9	15.1	21.0	17.5
10-14 YRS	ESTIMATE	2538	1544	10327	15760	114	347	2657	6221	39507
	% STD ERR	16.7	15.0	14.0	9.4	*	37.8	29.2	8.2	5.5
	ROW %	6.4	3.9	26.1	39.9	0.3	0.9	6.7	15.7	
	COLUMN %	6.8	11.1	18.8	24.8	78.1	59.5	30.4	18.8	18.6
15-19 YRS	ESTIMATE	2721	1073	9934	8214	13	23	1197	2534	25709
	% STD ERR	20.4	18.0	14.1	10.7	*	*	31.2	14.8	6.7
	ROW %	10.6	4.2	38.6	31.9	0.1	0.1	4.7	9.9	
	COLUMN %	7.2	7.7	18.1	12.9	8.9	3.9	13.7	7.7	12.1
20-24 YRS	ESTIMATE	1694	896	5760	3930	0	37	468	894	13679
	% STD ERR	13.3	20.3	12.5	14.0	0.0	41.2	39.8	21.6	6.8
	ROW %	12.4	6.6	42.1	28.7	0.0	0.3	3.4	6.5	
	COLUMN %	4.5	6.5	10.5	6.2	0.0	6.3	5.4	2.7	6.4
25-29 YRS	ESTIMATE	2038	777	4544	2364	4	19	167	189	10101
	% STD ERR	8.3	14.7	6.4	14.5	*	*	25.1	19.1	4.5
	ROW %	20.2	7.7	45.0	23.4	0.0	0.2	1.7	1.9	
	COLUMN %	5.4	5.6	8.3	3.7	2.7	3.3	1.9	0.6	4.8
30-34 YRS	ESTIMATE	10879	2510	7147	1438	8	10	168	360	22490
	% STD ERR	3.3	9.8	4.2	14.8	*	*	28.3	19.0	1.9
	ROW %	48.4	11.2	31.8	6.3	0.0	0.0	0.7	1.6	
	COLUMN %	28.9	18.1	13.0	2.2	5.5	1.7	1.9	1.1	10.6
35+ YRS	ESTIMATE	6084	689	998	266	0	3	42	109	8191
	% STD ERR	3.9	10.3	9.9	31.4	0.0	*	37.9	41.1	3.2
	ROW %	74.3	8.4	12.2	3.2	0.0	0.0	0.5	1.3	
	COLUMN %	16.2	5.0	1.8	0.4	0.0	0.5	0.5	0.3	3.9

TABLE 8. HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP (CONTINUED)

1977

		1	2	3	4	5	6	7	8	TOTALS
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

KEY

GROUP

1. NO REGULATORY AVIONICS
2. TWO-WAY COMMUNICATIONS
3. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   VOR OR ADF OR RNAV
4. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   VOR OR RNAV
5. 4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
6. TWO-WAY COMMUNICATIONS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
7. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
8. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   ALTITUDE ENCODING EQUIPMENT
   4096 CODE TRANSPONDER
   VOR } OR RNAV
   DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 9. HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
TYPE 1[1]	ESTIMATE	29391	6872	30205	7232	13	15	633	95	74455
	% STD ERR	2.7	11.6	4.4	14.4	*	*	32.4	*	0.0
	ROW %	39.5	9.2	40.6	9.7	0.0	0.0	0.9	0.1	
	COLUMN %	78.2	49.6	55.0	11.4	8.9	2.6	7.2	0.3	35.0
TYPE 2	ESTIMATE	2997	1810	23122	50134	127	256	6829	12917	98191
	% STD ERR	14.4	23.4	7.2	4.0	*	48.7	15.7	8.3	0.0
	ROW %	3.1	1.8	23.5	51.1	0.1	0.3	7.0	13.2	
	COLUMN %	8.0	13.1	42.1	78.8	87.0	43.9	78.1	39.0	46.2
TYPE 3	ESTIMATE	156	134	378	3641	0	84	787	10511	15690
	% STD ERR	22.3	*	33.4	10.2	0.0	*	21.6	3.8	0.0
	ROW %	1.0	0.9	2.4	23.2	0.0	0.5	5.0	67.0	
	COLUMN %	0.4	1.0	0.7	5.7	0.0	14.4	9.0	31.7	7.4
TYPE 4	ESTIMATE	393	222	328	1266	0	95	324	4532	7161
	% STD ERR	16.9	20.2	16.2	9.0	0.0	38.5	19.8	2.8	0.0
	ROW %	5.5	3.1	4.6	17.7	0.0	1.3	4.5	63.3	
	COLUMN %	1.0	1.6	0.6	2.0	0.0	16.3	3.7	13.7	3.4
TYPE 5	ESTIMATE	39	7	75	157	0	0	8	67	353
	% STD ERR	18.8	*	14.5	8.1	0.0	0.0	42.9	14.6	0.0
	ROW %	11.0	2.0	21.2	44.5	0.0	0.0	2.3	19.0	
	COLUMN %	0.1	0.1	0.1	0.2	0.0	0.0	0.1	0.2	0.2
TYPE 6	ESTIMATE	0	2	5	33	2	40	38	2176	2295
	% STD ERR	0.0	*	*	*	*	*	*	1.7	0.0
	ROW %	0.0	0.1	0.2	1.4	0.1	1.7	1.7	94.8	
	COLUMN %	0.0	0.0	0.0	0.1	1.4	6.9	0.4	6.6	1.1
TYPE 7	ESTIMATE	0	0	0	117	0	0	49	415	581
	% STD ERR	0.0	0.0	0.0	30.4	0.0	0.0	45.8	9.0	0.0
	ROW %	0.0	0.0	0.0	20.1	0.0	0.0	8.4	71.4	
	COLUMN %	0.0	0.0	0.0	0.2	0.0	0.0	0.6	1.3	0.3
TYPE 8	ESTIMATE	1	4	3	21	0	0	1	64	96
	% STD ERR	0.0	38.0	*	17.7	0.0	0.0	*	6.3	0.0
	ROW %	1.0	4.2	3.1	21.9	0.0	0.0	1.0	66.7	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

1 See Table 4 for type definitions.

TABLE 9. HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

1977

		1	2	3	4	5	6	7	8	TOTALS
TYPE 9	ESTIMATE	16	0	0	32	0	58	5	1883	1994
	% STD ERR	*	0.0	0.0	*	0.0	45.0	36.2	1.7	0.0
	ROW %	0.8	0.0	0.0	1.6	0.0	2.9	0.3	94.4	
	COLUMN %	0.0	0.0	0.0	0.1	0.0	9.9	0.1	5.7	0.9
TYPE 10	ESTIMATE	60	27	19	42	2	17	20	311	499
	% STD ERR	14.2	27.8	20.4	26.6	42.9	34.8	45.2	5.1	0.0
	ROW %	12.0	5.4	3.8	8.4	0.4	3.4	4.0	62.3	
	COLUMN %	0.2	0.2	0.0	0.1	1.4	2.9	0.2	0.9	0.2
TYPE 11	ESTIMATE	1961	2136	374	151	0	11	3	17	4652
	% STD ERR	8.0	8.1	23.2	36.3	0.0	*	*	*	0.0
	ROW %	42.2	45.9	8.0	3.2	0.0	0.2	0.1	0.4	
	COLUMN %	5.2	15.4	0.7	0.2	0.0	1.9	0.0	0.1	2.2
TYPE 12	ESTIMATE	148	680	394	795	1	8	35	132	2193
	% STD ERR	32.0	17.9	26.0	16.8	33.7	*	43.7	45.2	0.0
	ROW %	6.7	31.0	18.0	36.3	0.0	0.4	1.6	6.0	
	COLUMN %	0.4	4.9	0.7	1.2	0.7	1.4	0.4	0.4	1.0
TYPE 13	ESTIMATE	2428	1960	29	2	2	0	14	0	4435
	% STD ERR	4.1	5.1	*	*	*	0.0	*	0.0	0.0
	ROW %	54.7	44.2	0.7	0.0	0.0	0.0	0.3	0.0	
	COLUMN %	6.5	14.1	0.1	0.0	1.4	0.0	0.2	0.0	2.1
ALL CRAFT	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

KEY

GROUP
1. NO REGULATORY AVIONICS
2. TWO-WAY COMMUNICATIONS
3. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   VOR OR RNAV
5. 4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
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NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 10. HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP
1977

		1	2	3	4	5	6	7	8	TOTALS
GLIDER	ESTIMATE	1458	1768	27	2	0	0	6	0	3260
	% STD ERR	6.4	5.3	*	*	0.0	0.0	*	0.0	1.3
	ROW %	44.7	54.2	0.8	0.1	0.0	0.0	0.2	0.0	
	COLUMN %	3.9	12.8	0.0	0.0	0.0	0.0	0.1	0.0	1.5
BALLOON	ESTIMATE	970	192	3	0	2	0	4	0	1170
	% STD ERR	5.2	17.0	*	0.0	*	0.0	*	0.0	3.5
	ROW %	82.9	16.4	0.3	0.0	0.2	0.0	0.3	0.0	
	COLUMN %	2.6	1.4	0.0	0.0	1.4	0.0	0.0	0.0	0.6
BLIMP	ESTIMATE	0	0	0	0	0	0	5	0	5
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	*	0.0	*
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
FIXED WING ENG=1	ESTIMATE	32449	8713	53344	57388	141	288	7467	13052	172842
	% STD ERR	2.8	10.4	4.0	3.9	*	43.7	14.6	8.2	0.0
	ROW %	18.8	5.0	30.9	33.2	0.1	0.2	4.3	7.6	
	COLUMN %	86.3	62.9	97.1	90.2	96.6	49.4	85.4	39.4	81.3
FIXED WING ENG>1	ESTIMATE	603	365	792	5287	2	277	1227	19920	28473
	% STD ERR	12.7	24.3	17.4	7.4	*	31.2	15.0	2.1	0.0
	ROW %	2.1	1.3	2.8	18.6	0.0	1.0	4.3	70.0	
	COLUMN %	1.6	2.6	1.4	8.3	1.4	47.5	14.0	60.1	13.4
ROTORCRAFT	ESTIMATE	2109	2816	767	946	1	18	38	150	6845
	% STD ERR	7.8	7.5	17.5	15.2	33.7	*	41.3	44.5	0.0
	ROW %	30.8	41.1	11.2	13.8	0.0	0.3	0.6	2.2	
	COLUMN %	5.6	20.3	1.4	1.5	0.7	3.1	0.4	0.5	3.2
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

TABLE 10. HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP
1. NO REGULATORY AVIONICS

2. TWO-WAY COMMUNICATIONS

3. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
VOR OR RNAV

5. 4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

6. TWO-WAY COMMUNICATIONS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

GROUP
7. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

8. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
ALTITUDE ENCODING EQUIPMENT
4096 CODE TRANSPONDER
VOR } OR RNAV
DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 11. HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
RECIPROCAT	ESTIMATE	35018	11207	54482	62580	140	460	8589	28139	200615
	% STD ERR	2.6	8.2	3.9	3.6	*	32.4	12.9	4.1	0.0
	ROW %	17.5	5.6	27.2	31.2	0.1	0.2	4.3	14.0	
	COLUMN %	93.2	80.9	99.2	98.4	95.9	78.9	98.2	85.0	94.4
TURBOPROP	ESTIMATE	4	8	8	171	2	40	88	2655	2977
	% STD ERR	*	*	*	24.1	*	*	34.8	2.0	0.1
	ROW %	0.1	0.3	0.3	5.7	0.1	1.3	3.0	89.2	
	COLUMN %	0.0	0.1	0.0	0.3	1.4	6.9	1.0	8.0	1.4
TURBOSHAFT	ESTIMATE	143	678	394	796	1	8	35	133	2188
	% STD ERR	33.1	17.9	26.0	16.7	33.7	*	43.7	44.8	0.1
	ROW %	6.5	31.0	18.0	36.4	0.0	0.4	1.6	6.1	
	COLUMN %	0.4	4.9	0.7	1.3	0.7	1.4	0.4	0.4	1.0
TURBOJET	ESTIMATE	74	27	19	73	2	75	24	2194	2487
	% STD ERR	21.5	28.2	20.6	30.1	42.9	35.8	38.6	1.7	0.8
	ROW %	3.0	1.1	0.8	2.9	0.1	3.0	1.0	88.2	
	COLUMN %	0.2	0.2	0.0	0.1	1.4	12.9	0.3	6.6	1.2
TUR AIR GEN	ESTIMATE	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAMJET	ESTIMATE	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NO ENGINE	ESTIMATE	2346	1934	29	2	2	0	10	0	4322
	% STD ERR	4.2	5.1	*	*	*	0.0	*	0.0	0.7
	ROW %	54.3	44.7	0.7	0.0	0.0	0.0	0.2	0.0	
	COLUMN %	6.2	14.0	0.1	0.0	1.4	0.0	0.1	0.0	2.0
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

TABLE 11. HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP
1. NO REGULATORY AVIONICS

2. TWO-WAY COMMUNICATIONS

3. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
VOR OR RNAV

5. 4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

6. TWO-WAY COMMUNICATIONS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

GROUP
7. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

8. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
ALTITUDE ENCODING EQUIPMENT
4096 CODE TRANSPONDER
VOR } OR RNAV
DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 12. HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP

1977

		1	2	3	4	5	6	7	8	TOTALS
ONE	ESTIMATE	34600	11513	54056	58292	143	305	7500	13157	179565
	% STD ERR	2.7	8.1	3.9	3.5	*	41.4	14.6	8.2	0.0
	ROW %	19.3	6.4	30.1	32.5	0.1	0.2	4.2	7.3	
	COLUMN %	92.0	83.1	98.4	91.6	97.9	52.3	85.7	39.7	84.5
TWO	ESTIMATE	579	401	767	5130	2	278	1213	19562	27931
	% STD ERR	13.2	22.4	18.0	7.6	*	31.1	15.2	2.2	0.0
	ROW %	2.1	1.4	2.7	18.4	0.0	1.0	4.3	70.0	
	COLUMN %	1.5	2.9	1.4	8.1	1.4	47.7	13.9	59.1	13.1
THREE	ESTIMATE	2	2	0	4	0	0	13	61	82
	% STD ERR	*	*	0.0	*	0.0	0.0	*	16.9	9.8
	ROW %	2.4	2.4	0.0	4.9	0.0	0.0	15.9	74.4	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0
FOUR	ESTIMATE	37	5	81	195	0	0	11	341	670
	% STD ERR	18.5	*	13.8	8.5	0.0	0.0	35.2	4.6	1.3
	ROW %	5.5	0.7	12.1	29.1	0.0	0.0	1.6	50.9	
	COLUMN %	0.1	0.0	0.1	0.3	0.0	0.0	0.1	1.0	0.3
MORE	ESTIMATE	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONE	ESTIMATE	2371	1933	29	2	2	0	10	0	4347
	% STD ERR	4.2	5.1	*	*	*	0.0	*	0.0	0.6
	ROW %	54.5	44.5	0.7	0.0	0.0	0.0	0.2	0.0	
	COLUMN %	6.3	14.0	0.1	0.0	1.4	0.0	0.1	0.0	2.0
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

TABLE 12. HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP
1. NO REGULATORY AVIONICS

2. TWO-WAY COMMUNICATIONS

3. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
4096 CODE TRANSPONDER
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5. 4096 CODE TRANSPONDER
ALTITUDE ENCODING EQUIPMENT

6. TWO-WAY COMMUNICATIONS
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7. TWO-WAY COMMUNICATIONS
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8. TWO-WAY COMMUNICATIONS
TWO SYSTEMS - AIR TAXIS
ALTITUDE ENCODING EQUIPMENT
4096 CODE TRANSPONDER
VOR } OR RNAV
DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 13. HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP
1977

		1	2	3	4	5	6	7	8	TOTALS
1 SEAT	ESTIMATE	10233	3152	1007	77	0	5	10	31	14515
	% STD ERR	3.9	9.4	21.3	32.6	0.0	*	*	42.4	2.6
	ROW %	70.5	21.7	6.9	0.5	0.0	0.0	0.1	0.2	
	COLUMN %	27.2	22.8	1.8	0.1	0.0	0.9	0.1	0.1	6.8
2 SEATS	ESTIMATE	18846	5315	25620	6940	15	25	497	88	57345
	% STD ERR	3.9	14.0	5.1	14.5	*	*	39.3	*	0.7
	ROW %	32.9	9.3	44.7	12.1	0.0	0.0	0.9	0.2	
	COLUMN %	50.1	38.4	46.6	10.9	10.3	4.3	5.7	0.3	27.0
3 SEATS	ESTIMATE	4099	2113	3940	417	2	13	149	20	10753
	% STD ERR	6.6	10.3	6.1	24.5	*	*	43.0	*	1.6
	ROW %	38.1	19.7	36.6	3.9	0.0	0.1	1.4	0.2	
	COLUMN %	10.9	15.3	7.2	0.7	1.4	2.2	1.7	0.1	5.1
4 SEATS	ESTIMATE	2957	1965	21694	42585	114	16	6011	7899	83242
	% STD ERR	14.5	21.2	7.6	4.6	*	*	17.5	11.9	8.7
	ROW %	3.6	2.4	26.1	51.2	0.1	0.0	7.2	9.5	
	COLUMN %	7.9	14.2	39.5	66.9	78.1	2.7	68.7	23.8	39.2
5 SEATS	ESTIMATE	455	468	1140	3964	0	0	409	2111	8547
	% STD ERR	15.6	25.3	14.7	11.0	0.0	0.0	30.3	17.0	6.0
	ROW %	5.3	5.5	13.3	46.4	0.0	0.0	4.8	24.7	
	COLUMN %	1.2	3.4	2.1	6.2	0.0	0.0	4.7	6.4	4.0
6 SEATS	ESTIMATE	192	402	926	7710	1	329	1069	13426	24057
	% STD ERR	32.8	31.0	20.3	7.8	33.7	42.7	22.8	4.7	2.8
	ROW %	0.8	1.7	3.8	32.0	0.0	1.4	4.4	55.8	
	COLUMN %	0.5	2.9	1.7	12.1	0.7	56.4	12.2	40.5	11.3
7-11 SEATS	ESTIMATE	326	284	329	1352	14	187	487	7811	10790
	% STD ERR	13.8	16.9	13.3	11.4	*	25.9	23.0	2.6	1.8
	ROW %	3.0	2.6	3.0	12.5	0.1	1.7	4.5	72.4	
	COLUMN %	0.9	2.1	0.6	2.1	9.6	32.1	5.6	23.6	5.1
12-19 SEATS	ESTIMATE	216	182	93	239	0	1	47	491	1269
	% STD ERR	11.7	11.3	18.0	16.0	0.0	*	40.1	9.3	3.1
	ROW %	17.0	14.3	7.3	18.8	0.0	0.1	3.7	38.7	
	COLUMN %	0.6	1.3	0.2	0.4	0.0	0.2	0.5	1.5	0.6

TABLE 13. HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP (CONTINUED)

1977

		1	2	3	4	5	6	7	8	TOTALS
20-49 SEATS	ESTIMATE	174	12	91	172	0	6	38	696	1190
	% STD ERR	30.8	*	38.9	26.8	0.0	*	41.4	8.8	1.5
	ROW %	14.6	1.0	7.6	14.5	0.0	0.5	3.2	58.5	
	COLUMN %	0.5	0.1	0.2	0.3	0.0	1.0	0.4	2.1	0.6
50+ SEATS	ESTIMATE	50	0	91	166	0	0	30	549	885
	% STD ERR	16.5	0.0	11.9	6.8	0.0	0.0	31.3	4.6	2.5
	ROW %	5.6	0.0	10.3	18.8	0.0	0.0	3.4	62.0	
	COLUMN %	0.1	0.0	0.2	0.3	0.0	0.0	0.3	1.7	0.4
TOTALS	ESTIMATE	37589	13853	54933	63622	146	583	8747	33121	212598
	% STD ERR	2.5	6.8	3.9	3.6	*	26.2	12.7	3.5	
	ROW %	17.7	6.5	25.8	29.9	0.1	0.3	4.1	15.6	

KEY

GROUP
1. NO REGULATORY AVIONICS
2. TWO-WAY COMMUNICATIONS
3. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   VOR OR ADF OR RNAV

GROUP
4. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   VOR OR RNAV
5. 4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
6. TWO-WAY COMMUNICATIONS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT

GROUP
7. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   4096 CODE TRANSPONDER
   ALTITUDE ENCODING EQUIPMENT
8. TWO-WAY COMMUNICATIONS
   TWO SYSTEMS - AIR TAXIS
   ALTITUDE ENCODING EQUIPMENT
   4096 CODE TRANSPONDER
   VOR } OR RNAV
   DME }

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 14. NON-HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
EXECUTIVE	ESTIMATE	199	157	3758	4278	859	4331	32	32	19	487	8924
	% STD ERR	42.2	*	10.2	5.5	8.5	5.4	44.4	44.4	*	28.9	5.1
	ROW %	2.2	1.8	42.1	47.9	9.6	48.5	0.4	0.4	0.2	5.5	
	COLUMN %	1.1	1.0	6.8	44.7	47.3	43.8	4.6	5.1	11.7	0.4	4.2
BUSINESS	ESTIMATE	2395	4681	20105	2770	426	2827	183	181	36	11835	41811
	% STD ERR	19.6	17.0	6.2	16.5	27.5	16.2	45.2	45.2	*	11.7	4.6
	ROW %	5.7	11.2	48.1	6.6	1.0	6.8	0.4	0.4	0.1	28.3	
	COLUMN %	13.2	29.2	36.2	28.9	23.6	28.6	26.6	28.9	22.1	10.5	19.7
PERSONAL	ESTIMATE	8569	9184	16980	936	256	1091	428	371	108	54615	98351
	% STD ERR	14.1	13.7	8.4	32.8	*	29.9	*	*	*	4.0	2.7
	ROW %	9.5	10.2	18.8	1.0	0.3	1.2	0.5	0.4	0.1	60.4	
	COLUMN %	47.3	57.2	30.6	9.8	14.2	11.0	62.1	59.3	66.3	48.3	42.5
AERIAL AP.	ESTIMATE	175	81	140	1	0	1	0	0	0	7209	7606
	% STD ERR	27.0	*	*	*	0.0	*	0.0	0.0	0.0	4.1	4.1
	ROW %	2.3	1.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	94.8	
	COLUMN %	1.0	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	6.4	3.6
INSTRUCT.	ESTIMATE	2765	580	4273	340	0	340	5	5	0	8183	16141
	% STD ERR	30.7	*	21.0	37.2	0.0	37.2	*	*	0.0	16.0	10.6
	ROW %	17.1	3.6	26.5	2.1	0.0	2.1	0.0	0.0	0.0	50.7	
	COLUMN %	15.2	3.6	7.7	3.6	0.0	3.4	0.7	0.8	0.0	7.2	7.6
AIR TAXI	ESTIMATE	482	610	4113	557	53	565	1	1	0	1171	6969
	% STD ERR	36.4	30.7	9.7	17.6	27.2	17.4	*	*	0.0	16.7	7.3
	ROW %	6.9	8.8	59.0	8.0	0.8	8.1	0.0	0.0	0.0	16.8	
	COLUMN %	2.7	3.8	7.4	5.8	2.9	5.7	0.1	0.2	0.0	1.0	3.3
INDUSTR SP	ESTIMATE	157	54	331	31	32	31	0	0	0	797	1378
	% STD ERR	43.6	*	45.1	*	*	*	0.0	0.0	0.0	22.1	17.7
	ROW %	11.4	3.9	24.0	2.2	2.3	2.2	0.0	0.0	0.0	57.8	
	COLUMN %	0.9	0.3	0.6	0.3	1.8	0.3	0.0	0.0	0.0	0.7	0.6
RENTAL	ESTIMATE	732	247	4344	216	42	216	0	0	0	3257	8796
	% STD ERR	*	*	20.0	*	20.8	*	0.0	0.0	0.0	27.7	15.1
	ROW %	8.3	2.8	49.4	2.5	0.5	2.5	0.0	0.0	0.0	37.0	
	COLUMN %	4.0	1.5	7.8	2.3	2.3	2.2	0.0	0.0	0.0	2.9	4.1

TABLE 14. NON-HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP (CONTINUED)

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
OTHER	ESTIMATE	531	237	940	265	110	281	21	17	0	3083	5064
	% STD ERR	*	42.4	18.5	27.5	*	26.1	*	*	0.0	11.7	11.0
	ROW %	10.5	4.7	18.6	5.2	2.2	5.5	0.4	0.3	0.0	60.9	
	COLUMN %	2.9	1.5	1.7	2.8	6.1	2.8	3.0	2.7	0.0	2.7	2.4
INACTIVE	ESTIMATE	975	494	978	103	33	120	17	16	6	22995	25554
	% STD ERR	28.6	31.3	18.0	19.8	39.7	19.1	*	*	*	4.0	3.9
	ROW %	3.8	1.9	3.8	0.4	0.1	0.5	0.1	0.1	0.0	90.0	
	COLUMN %	5.4	3.1	1.8	1.1	1.8	1.2	2.5	2.6	3.7	20.3	12.0
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
ME:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 15. NON-HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
1-49	ESTIMATE	3931	2980	4224	687	100	740	41	24	10	30131	41982
	% STD ERR	20.4	21.9	14.5	49.9	*	46.8	*	33.3	36.3	5.3	4.7
	ROW %	9.4	7.1	10.1	1.6	0.2	1.8	0.1	0.1	0.0	71.8	
	COLUMN %	21.7	18.6	7.6	7.2	5.5	7.5	6.0	3.8	6.1	26.6	19.7
50-99	ESTIMATE	3392	2676	8068	943	126	1067	308	271	0	23479	38601
	% STD ERR	21.7	22.4	11.8	31.9	*	29.8	*	*	0.0	7.7	5.5
	ROW %	8.8	6.9	20.9	2.4	0.3	2.8	0.8	0.7	0.0	60.8	
	COLUMN %	18.7	16.7	14.5	9.8	7.0	10.8	44.7	43.3	0.0	20.8	18.2
100-149	ESTIMATE	2540	4009	8786	805	286	830	136	131	110	11247	27389
	% STD ERR	23.7	21.3	10.4	22.8	48.5	22.2	*	*	*	11.2	6.6
	ROW %	9.3	14.6	32.1	2.9	1.0	3.0	0.5	0.5	0.4	41.1	
	COLUMN %	14.0	25.0	15.8	8.4	15.8	8.4	19.7	20.9	67.5	9.9	12.9
150-199	ESTIMATE	975	2577	7689	571	56	602	11	9	2	5202	17025
	% STD ERR	48.9	30.1	13.7	27.6	45.2	26.6	*	*	*	14.3	9.0
	ROW %	5.7	15.1	45.2	3.4	0.3	3.5	0.1	0.1	0.0	30.6	
	COLUMN %	5.4	16.1	13.8	6.0	3.1	6.1	1.6	1.4	1.2	4.6	8.0
200-249	ESTIMATE	1322	1431	6858	716	174	716	10	10	1	4604	14931
	% STD ERR	40.7	28.0	12.2	18.9	29.1	18.9	*	*	*	17.6	8.8
	ROW %	8.9	9.6	45.9	4.8	1.2	4.8	0.1	0.1	0.0	30.8	
	COLUMN %	7.3	8.9	12.3	7.5	9.6	7.2	1.5	1.6	0.6	4.1	7.0
250-299	ESTIMATE	329	220	2980	882	235	884	32	32	24	2318	6738
	% STD ERR	*	*	18.0	19.6	23.8	19.5	*	*	*	24.7	12.2
	ROW %	4.9	3.3	44.2	13.1	3.5	13.1	0.5	0.5	0.4	34.4	
	COLUMN %	1.8	1.4	5.4	9.2	13.2	8.9	4.6	5.1	14.7	2.1	3.2
300-349	ESTIMATE	953	398	4640	794	163	804	1	1	0	2817	9665
	% STD ERR	*	46.1	15.5	19.5	41.4	19.3	*	*	0.0	25.1	12.0
	ROW %	10.3	4.1	48.0	8.2	1.7	8.3	0.0	0.0	0.0	29.1	
	COLUMN %	5.5	2.5	8.3	8.3	9.0	8.1	0.1	0.2	0.0	2.5	4.5
350-399	ESTIMATE	61	297	1957	609	92	609	68	68	0	2851	5775
	% STD ERR	*	*	21.8	18.6	35.9	18.6	*	*	0.0	26.9	16.0
	ROW %	1.1	5.1	33.9	10.5	1.6	10.5	1.2	1.2	0.0	49.4	
	COLUMN %	0.3	1.9	3.5	6.4	5.1	6.2	9.9	10.9	0.0	2.5	2.7

TABLE 15. NON-HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP (CONTINUED)

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
400-449	ESTIMATE	646	94	2278	671	124	704	23	23	0	2182	5900
	% STD ERR	*	*	24.6	23.0	27.2	22.2	*	*	0.0	36.8	18.0
	ROW %	10.9	1.6	38.6	11.4	2.1	11.9	0.4	0.4	0.0	37.0	
	COLUMN %	3.6	0.6	4.1	7.0	6.9	7.1	3.3	3.7	0.0	1.9	2.8
450 UP	ESTIMATE	1814	1149	7511	2710	415	2720	55	53	16	5807	19035
	% STD ERR	33.5	35.6	11.9	8.6	14.6	8.6	*	*	*	16.5	7.7
	ROW %	9.5	6.0	39.5	14.2	2.2	14.3	0.3	0.3	0.1	30.5	
	COLUMN %	10.0	7.2	13.5	28.3	23.0	27.5	8.0	8.5	9.8	5.1	9.0
INACTIVE	ESTIMATE	975	494	978	103	33	120	17	16	6	22995	25554
	% STD ERR	28.6	31.3	18.0	19.8	39.7	19.1	*	*	*	4.0	3.9
	ROW %	3.8	1.9	3.8	0.4	0.1	0.5	0.1	0.1	0.0	90.0	
	COLUMN %	5.4	3.1	1.8	1.1	1.8	1.2	2.5	2.6	3.7	20.3	12.0
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
MB:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 16. NON-HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
0-4 YRS	ESTIMATE	5044	1650	20136	4561	617	4616	104	97	5	24235	55695
	% STD ERR	21.5	35.3	7.1	10.8	17.9	10.7	46.0	49.1	*	7.3	4.1
	ROW %	9.1	3.0	36.2	8.2	1.1	8.3	0.2	0.2	0.0	43.5	
	COLUMN %	27.8	10.3	36.2	47.6	34.2	46.7	15.1	15.5	3.1	21.4	26.2
5-9 YRS	ESTIMATE	2941	3894	11979	2311	407	2327	471	442	112	16019	37214
	% STD ERR	27.6	22.8	10.1	14.7	31.8	14.6	*	*	*	9.3	5.7
	ROW %	7.9	10.5	32.2	6.2	1.1	6.3	1.3	1.2	0.3	43.0	
	COLUMN %	16.2	24.3	21.6	24.1	22.5	23.6	68.4	70.6	68.7	14.2	17.5
10-14 YRS	ESTIMATE	3149	5096	12924	1631	284	1656	40	40	14	16702	39507
	% STD ERR	29.8	17.9	8.7	12.4	17.5	12.3	42.1	42.1	50.0	9.8	5.5
	ROW %	8.0	12.9	32.7	4.1	0.7	4.2	0.1	0.1	0.0	42.3	
	COLUMN %	17.4	31.8	23.3	17.0	15.7	16.8	5.8	6.4	8.6	14.8	18.6
15-19 YRS	ESTIMATE	2937	2872	6057	762	386	820	22	22	0	13081	25709
	% STD ERR	22.5	21.6	9.9	21.8	35.3	21.1	31.9	31.9	0.0	11.1	6.7
	ROW %	11.4	11.2	23.6	3.0	1.5	3.2	0.1	0.1	0.0	50.9	
	COLUMN %	16.2	17.9	10.9	8.0	21.4	8.3	3.2	3.5	0.0	11.6	12.1
20-24 YRS	ESTIMATE	1311	1636	2117	131	51	251	17	17	2	8472	13679
	% STD ERR	22.4	25.0	14.0	40.9	28.9	46.6	38.0	38.0	47.5	9.2	6.8
	ROW %	9.6	12.0	15.5	1.0	0.4	1.8	0.1	0.1	0.0	61.9	
	COLUMN %	7.2	10.2	3.8	1.4	2.8	2.5	2.5	2.7	1.2	7.5	6.4
25-29 YRS	ESTIMATE	868	688	900	64	24	70	14	2	0	7565	10101
	% STD ERR	18.3	24.0	18.0	32.0	34.8	30.1	*	*	0.0	5.3	4.5
	ROW %	8.6	6.8	8.9	0.6	0.2	0.7	0.1	0.0	0.0	74.9	
	COLUMN %	4.8	4.3	1.6	0.7	1.3	0.7	2.0	0.3	0.0	6.7	4.8
30-34 YRS	ESTIMATE	1116	405	860	54	19	70	16	10	8	20047	22490
	% STD ERR	12.3	28.3	16.2	35.8	*	31.7	*	*	*	2.0	1.9
	ROW %	5.0	1.8	3.8	0.2	0.1	0.3	0.1	0.0	0.0	89.1	
	COLUMN %	6.2	2.5	1.5	0.6	1.1	0.7	2.3	1.6	4.9	17.7	10.6
35+ YRS	ESTIMATE	193	71	294	12	5	12	13	4	0	7611	8191
	% STD ERR	29.9	*	21.6	*	*	*	*	*	0.0	3.2	3.2
	ROW %	2.4	0.9	3.6	0.1	0.1	0.1	0.2	0.0	0.0	92.9	
	COLUMN %	1.1	0.4	0.5	0.1	0.3	0.1	1.9	0.6	0.0	6.7	3.9

TABLE 16. NON-HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP (CONTINUED)

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
ME:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 17. NON-HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP
1977

[1]		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
TYPE 1	ESTIMATE	6452	1458	928	33	51	33	32	17	4	65501	74455
	% STD ERR	16.0	23.1	26.7	*	*	*	*	*	*	1.6	0.0
	ROW %	8.7	2.0	1.2	0.0	0.1	0.0	0.0	0.0	0.0	88.0	
	COLUMN %	35.8	9.1	1.7	0.3	2.8	0.3	4.6	2.7	2.5	57.9	35.0
TYPE 2	ESTIMATE	10780	13891	36606	1383	411	1570	388	340	106	35466	98191
	% STD ERR	12.7	10.3	4.9	33.0	44.1	29.9	*	*	*	5.3	0.0
	ROW %	11.0	14.1	37.3	1.4	0.4	1.6	0.4	0.3	0.1	36.1	
	COLUMN %	59.5	86.5	65.9	14.4	22.8	15.9	56.3	54.3	65.0	31.4	46.2
TYPE 3	ESTIMATE	253	545	11648	2593	135	2618	98	98	24	650	15690
	% STD ERR	28.3	29.8	3.3	12.6	42.7	12.6	47.1	47.1	*	26.7	0.0
	ROW %	1.6	3.5	74.2	16.5	0.9	16.7	0.6	0.6	0.2	4.1	
	COLUMN %	1.4	3.4	21.0	27.1	7.5	26.5	14.2	15.7	14.7	0.6	7.4
TYPE 4	ESTIMATE	171	37	4850	1374	104	1391	115	115	10	716	7161
	% STD ERR	23.7	47.3	[illegible]	11.6	30.1	11.5	*	*	29.9	10.8	0.0
	ROW %	2.4	0.5	[illegible]	19.2	1.5	19.4	1.6	1.6	0.1	10.0	
	COLUMN %	0.9	0.2	[illegible]	14.3	5.8	14.1	16.7	18.4	6.1	0.6	3.4
TYPE 5	ESTIMATE	11	5	[illegible]	44	26	44	0	0	0	118	353
	% STD ERR	36.9	*	[illegible]	19.8	29.4	19.8	0.0	0.0	0.0	8.4	0.0
	ROW %	3.1	1.4	49.6	12.5	7.4	12.5	0.0	0.0	0.0	33.4	
	COLUMN %	0.1	0.0	0.3	0.5	1.4	0.4	0.0	0.0	0.0	0.1	0.2
TYPE 6	ESTIMATE	0	14	481	1758	107	1796	10	10	2	15	2295
	% STD ERR	0.0	*	15.5	4.4	30.8	4.1	*	*	*	*	0.0
	ROW %	0.0	0.6	21.0	76.6	4.7	78.3	0.4	0.4	0.1	0.7	
	COLUMN %	0.0	0.1	0.9	18.4	5.9	18.2	1.5	1.6	1.2	0.0	1.1
TYPE 7	ESTIMATE	8	0	343	230	58	238	15	15	0	0	581
	% STD ERR	76.1	0.0	10.4	15.5	36.8	15.0	*	*	0.0	0.0	0.0
	ROW %	1.4	0.0	59.0	39.6	10.0	41.0	2.6	2.6	0.0	0.0	
	COLUMN %	0.0	0.0	0.6	2.4	3.2	2.4	2.2	2.4	0.0	0.0	0.3
TYPE 8	ESTIMATE	3	0	34	49	20	49	0	0	0	10	96
	% STD ERR	0.0	0.0	15.5	11.2	22.3	11.2	0.0	0.0	0.0	28.6	0.0
	ROW %	3.1	0.0	35.4	51.0	20.8	51.0	0.0	0.0	0.0	10.4	
	COLUMN %	0.0	0.0	0.1	0.5	1.1	0.5	0.0	0.0	0.0	0.0	0.0

1 See Table 4 for type definitions.

TABLE 17. NON-HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
TYPE 9	ESTIMATE	2	1	243	1729	612	1729	16	16	9	19	1994
	% STD ERR	0.0	*	16.5	2.4	5.8	2.4	*	*	*	*	0.0
	ROW %	0.1	0.1	12.2	86.7	30.7	86.7	0.8	0.8	0.5	1.0	
	COLUMN %	0.0	0.0	0.4	18.1	33.9	17.5	2.3	2.6	5.5	0.0	0.9
TYPE 10	ESTIMATE	17	11	96	259	218	270	14	14	8	117	499
	% STD ERR	*	*	14.5	7.1	8.4	5.7	*	*	*	8.0	0.0
	ROW %	3.4	2.2	19.2	51.9	43.7	54.1	2.8	2.8	1.6	23.4	
	COLUMN %	0.1	0.1	0.2	2.7	12.1	2.7	2.0	2.2	4.9	0.1	0.2
TYPE 11	ESTIMATE	77	0	1	15	12	16	1	0	0	4555	4652
	% STD ERR	33.3	0.0	0.0	*	*	*	*	0.0	0.0	0.9	0.0
	ROW %	1.7	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	97.9	
	COLUMN %	0.4	0.0	0.0	0.2	0.7	0.2	0.1	0.0	0.0	4.0	2.2
TYPE 12	ESTIMATE	317	84	172	108	50	124	0	0	0	1467	2193
	% STD ERR	31.7	*	*	50.0	28.1	44.3	0.0	0.0	0.0	8.8	0.0
	ROW %	14.5	3.8	7.8	4.9	2.3	5.7	0.0	0.0	0.0	66.9	
	COLUMN %	1.7	0.5	0.3	1.1	2.8	1.3	0.0	0.0	0.0	1.3	1.0
TYPE 13	ESTIMATE	2	5	0	0	0	0	0	0	0	4428	4435
	% STD ERR	*	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	ROW %	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.8	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	2.1
ALL CRAFT	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
MB:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 18. NON-HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
GLIDER	ESTIMATE	2	0	0	0	0	0	0	0	0	3258	3260
	% STD ERR	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3
	ROW %	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.9	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	1.5
BALLOON	ESTIMATE	0	0	0	0	0	0	0	0	0	1170	1170
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6
BLIMP	ESTIMATE	0	5	0	0	0	0	0	0	0	0	5
	% STD ERR	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
	ROW %	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIXED WING ENG=1	ESTIMATE	17285	15349	37587	1425	467	1613	422	361	112	101088	172842
	% STD ERR	9.9	9.6	4.8	32.1	40.5	29.2	*	*	*	2.1	0.0
	ROW %	10.0	8.9	21.7	0.8	0.3	0.9	0.2	0.2	0.1	58.5	
	COLUMN %	95.3	95.6	67.6	14.9	25.9	16.3	61.2	57.7	68.7	89.4	81.3
FIXED WING ENG>1	ESTIMATE	452	612	17817	8028	1276	8125	265	265	51	1523	28473
	% STD ERR	18.3	26.9	2.4	4.7	6.8	4.6	31.2	31.2	*	12.5	0.0
	ROW %	1.6	2.1	62.6	28.2	4.5	28.5	0.9	0.9	0.2	5.3	
	COLUMN %	2.5	3.8	32.1	83.8	70.7	82.3	38.5	42.3	31.3	1.3	13.4
ROTORCRAFT	ESTIMATE	394	84	173	123	62	140	1	0	0	6023	6845
	% STD ERR	26.4	*	49.9	*	*	44.7	*	0.0	0.0	2.2	0.0
	ROW %	5.8	1.2	2.5	1.8	0.9	2.0	0.0	0.0	0.0	88.0	
	COLUMN %	2.2	0.5	0.3	1.3	3.4	1.4	0.1	0.0	0.0	5.3	3.2
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

TABLE 18. NON-HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
MB:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 19. NON-HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
RECIPROCAT	ESTIMATE	17784	15941	54208	5443	740	5672	633	570	144	107114	208615
	% STD ERR	9.7	9.3	3.4	10.8	27.4	10.5	42.0	46.2	*	2.8	0.0
	ROW %	8.9	7.9	27.0	2.7	0.4	2.8	0.3	0.3	0.1	53.4	
	COLUMN %	98.1	99.3	97.5	56.8	41.0	57.4	91.9	91.1	88.3	94.7	94.4
TURBOPROP	ESTIMATE	12	14	857	2037	186	2083	25	25	2	29	2977
	% STD ERR	24.3	*	9.6	4.2	21.2	4.0	*	*	*	39.1	0.1
	ROW %	0.4	0.5	28.8	68.4	6.2	70.0	0.8	0.8	0.1	1.0	
	COLUMN %	0.1	0.1	1.5	21.3	10.3	21.1	3.6	4.0	1.2	0.0	1.4
TURBOSHAFT	ESTIMATE	316	84	172	109	50	125	0	0	0	1462	2188
	% STD ERR	31.8	*	*	49.6	28.1	44.0	0.0	0.0	0.0	8.8	0.1
	ROW %	14.4	3.8	7.9	5.0	2.3	5.7	0.0	0.0	0.0	66.8	
	COLUMN %	1.7	0.5	0.3	1.1	2.8	1.3	0.0	0.0	0.0	1.3	1.0
TURBOJET	ESTIMATE	16	12	339	1987	830	1998	31	31	17	134	2487
	% STD ERR	*	*	12.6	2.3	4.8	2.2	36.7	36.7	*	12.8	0.0
	ROW %	0.6	0.5	13.6	79.9	33.4	80.3	1.2	1.2	0.7	5.4	
	COLUMN %	0.1	0.1	0.6	20.7	46.0	20.2	4.5	5.0	10.4	0.1	1.2
TUR AIR GEN	ESTIMATE	0	0	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAMJET	ESTIMATE	0	0	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NO ENGINE	ESTIMATE	2	0	0	0	0	0	0	0	0	4320	4322
	% STD ERR	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	2.0
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113862	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

TABLE 19. NON-HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
ME:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 20. NON-HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
ONE	ESTIMATE	17657	15419	37755	1506	493	1699	424	361	112	107101	179565
	% STD ERR	9.7	9.5	4.8	30.7	38.9	27.9	*	*	*	2.0	0.0
	ROW %	9.8	8.6	21.0	0.8	0.3	0.9	0.2	0.2	0.1	59.6	
	COLUMN %	97.4	96.1	67.9	15.7	27.3	17.2	61.5	57.7	68.7	94.7	84.5
TWO	ESTIMATE	456	616	17570	7727	1053	7826	254	254	44	1492	27931
	% STD ERR	18.2	26.7	2.4	4.9	8.1	4.8	32.4	32.4	*	12.8	0.0
	ROW %	1.6	2.2	62.9	27.7	3.8	28.0	0.9	0.9	0.2	5.3	
	COLUMN %	2.5	3.8	31.6	80.7	58.3	79.2	36.9	40.6	27.0	1.3	13.1
THREE	ESTIMATE	0	0	17	60	41	60	7	7	7	4	82
	% STD ERR	0.0	0.0	39.8	4.2	24.1	4.2	*	*	*	*	9.8
	ROW %	0.0	0.0	20.7	73.2	50.0	73.2	8.5	8.5	8.5	4.9	
	COLUMN %	0.0	0.0	0.0	0.6	2.3	0.6	1.0	1.1	4.3	0.0	0.0
FOUR	ESTIMATE	18	15	235	283	215	293	5	5	0	120	670
	% STD ERR	*	*	6.6	7.4	8.1	6.2	44.3	44.3	0.0	8.6	1.3
	ROW %	2.7	2.2	35.1	42.2	32.7	43.7	0.7	0.7	0.0	17.9	
	COLUMN %	0.1	0.1	0.4	3.0	12.1	3.0	0.7	0.8	0.0	0.1	0.3
MORE	ESTIMATE	0	0	0	0	0	0	0	0	0	0	0
	% STD ERR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONE	ESTIMATE	2	0	0	0	0	0	0	0	0	4345	4347
	% STD ERR	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
	ROW %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	
	COLUMN %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	2.0
TOTALS	ESTIMATE	18132	16050	55577	9576	1808	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

TABLE 20. NON-HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP		GROUP	
L:	LOCALIZER	RA:	RADAR ALTIMETER
MB:	MARKER BEACON	LRN:	LONG RANGE RNAV
GS:	GLIDE SLOPE	ML:	MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

TABLE 21. NON-HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
1 SEAT	ESTIMATE	181	5	51	12	0	12	1	0	0	14264	14515
	% STD ERR	49.0	*	41.1	*	0.0	*	*	0.0	0.0	2.7	2.6
	ROW %	1.2	0.0	0.4	0.1	0.0	0.1	0.0	0.0	0.0	98.3	
	COLUMN %	1.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	12.6	6.8
2 SEATS	ESTIMATE	5853	1451	877	24	34	24	35	20	6	49077	57345
	% STD ERR	17.4	23.2	27.8	*	*	*	*	*	*	2.3	0.7
	ROW %	10.3	2.5	1.5	0.0	0.1	0.0	0.1	0.0	0.0	85.6	
	COLUMN %	32.5	9.0	1.6	0.3	1.9	0.2	5.1	3.2	3.7	43.4	27.0
3 SEATS	ESTIMATE	514	13	50	17	37	17	0	0	0	10138	10753
	% STD ERR	24.2	*	*	*	*	*	0.0	0.0	0.0	2.0	1.6
	ROW %	4.8	0.1	0.5	0.2	0.3	0.2	0.0	0.0	0.0	94.3	
	COLUMN %	2.8	0.1	0.1	0.2	2.0	0.2	0.0	0.0	0.0	9.0	5.1
4 SEATS	ESTIMATE	9458	11633	27560	973	361	1151	341	324	106	33584	83242
	% STD ERR	14.2	12.0	6.3	43.4	46.9	37.8	*	*	*	5.5	0.7
	ROW %	11.4	14.0	33.1	1.2	0.4	1.4	0.4	0.4	0.1	40.3	
	COLUMN %	52.2	72.5	49.6	10.2	20.0	11.7	49.5	51.8	65.0	29.7	39.2
5 SEATS	ESTIMATE	1016	840	3851	438	7	468	9	7	0	2394	8547
	% STD ERR	24.5	23.4	11.4	37.7	47.1	36.4	*	*	0.0	9.3	6.0
	ROW %	11.9	9.8	45.1	5.1	0.1	5.5	0.1	0.1	0.0	28.0	
	COLUMN %	5.6	5.2	6.9	4.6	0.4	4.7	1.3	1.1	0.0	2.1	4.0
6 SEATS	ESTIMATE	747	1997	16315	2857	215	2898	135	107	24	2078	24057
	% STD ERR	25.8	16.6	4.4	12.0	41.3	11.8	45.1	*	*	13.5	2.8
	ROW %	3.1	8.3	67.8	11.9	0.9	12.0	0.6	0.4	0.1	8.6	
	COLUMN %	4.1	12.4	29.4	29.8	11.9	29.3	19.6	17.1	14.7	1.8	11.3
7-11 SEATS	ESTIMATE	242	76	5666	4110	495	4141	128	128	7	694	10790
	% STD ERR	21.9	32.5	4.7	4.6	11.3	4.6	*	*	*	8.8	1.8
	ROW %	2.2	0.7	52.5	38.1	4.6	38.4	1.2	1.2	0.1	6.4	
	COLUMN %	1.3	0.5	10.2	42.9	27.4	41.9	18.6	20.4	4.3	0.6	5.1
12-19 SEATS	ESTIMATE	51	29	345	363	108	370	15	15	0	449	1269
	% STD ERR	29.3	38.1	7.8	10.1	25.7	10.0	*	*	0.0	7.3	3.1
	ROW %	4.0	2.3	27.2	28.6	8.5	29.2	1.2	1.2	0.0	35.4	
	COLUMN %	0.3	0.2	0.6	3.8	6.0	3.7	2.2	2.4	0.0	0.4	0.6

TABLE 21. NON-HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP (CONTINUED)

1977

		L	L,MB	L,MB, GS	L,MB, GS,RA	LRN	RA	ML	L,MB, GS,ML	LRN,ML	NO GROUP	ALL CRAFT
20-49 SEATS	ESTIMATE	19	5	559	342	248	353	10	10	10	259	1190
	% STD ERR	24.8	*	11.3	8.8	10.7	8.5	34.9	34.9	34.9	22.0	1.5
	ROW %	1.6	0.4	47.0	28.7	20.8	29.7	0.8	0.8	0.8	21.8	
	COLUMN %	0.1	0.0	1.0	3.6	13.7	3.6	1.5	1.6	6.1	0.2	0.6
50+ SEATS	ESTIMATE	11	2	302	440	301	445	14	14	10	125	885
	% STD ERR	36.9	37.2	4.6	5.0	6.1	5.0	*	*	*	9.5	2.5
	ROW %	1.2	0.2	34.1	49.7	34.0	50.3	1.6	1.6	1.1	14.1	
	COLUMN %	0.1	0.0	0.5	4.6	16.7	4.5	2.0	2.2	6.1	0.1	0.4
TOTALS	ESTIMATE	18132	16050	55577	9576	1806	9878	689	626	163	113062	212598
	% STD ERR	9.5	9.2	3.3	6.2	11.7	6.1	38.7	42.2	*	1.9	
	ROW %	8.5	7.5	26.1	4.5	0.8	4.6	0.3	0.3	0.1	53.2	

KEY

GROUP

L: LOCALIZER

MB: MARKER BEACON

GS: GLIDE SLOPE

GROUP

RA: RADAR ALTIMETER

LRN: LONG RANGE RNAV

ML: MICROWAVE LANDING SYSTEM

NOTE : ROWS AND COLUMNS MAY NOT SUM TO PRINTED TOTALS DUE TO ESTIMATION PROCEDURES.
* STANDARD ERROR GREATER THAN 50 PERCENT.

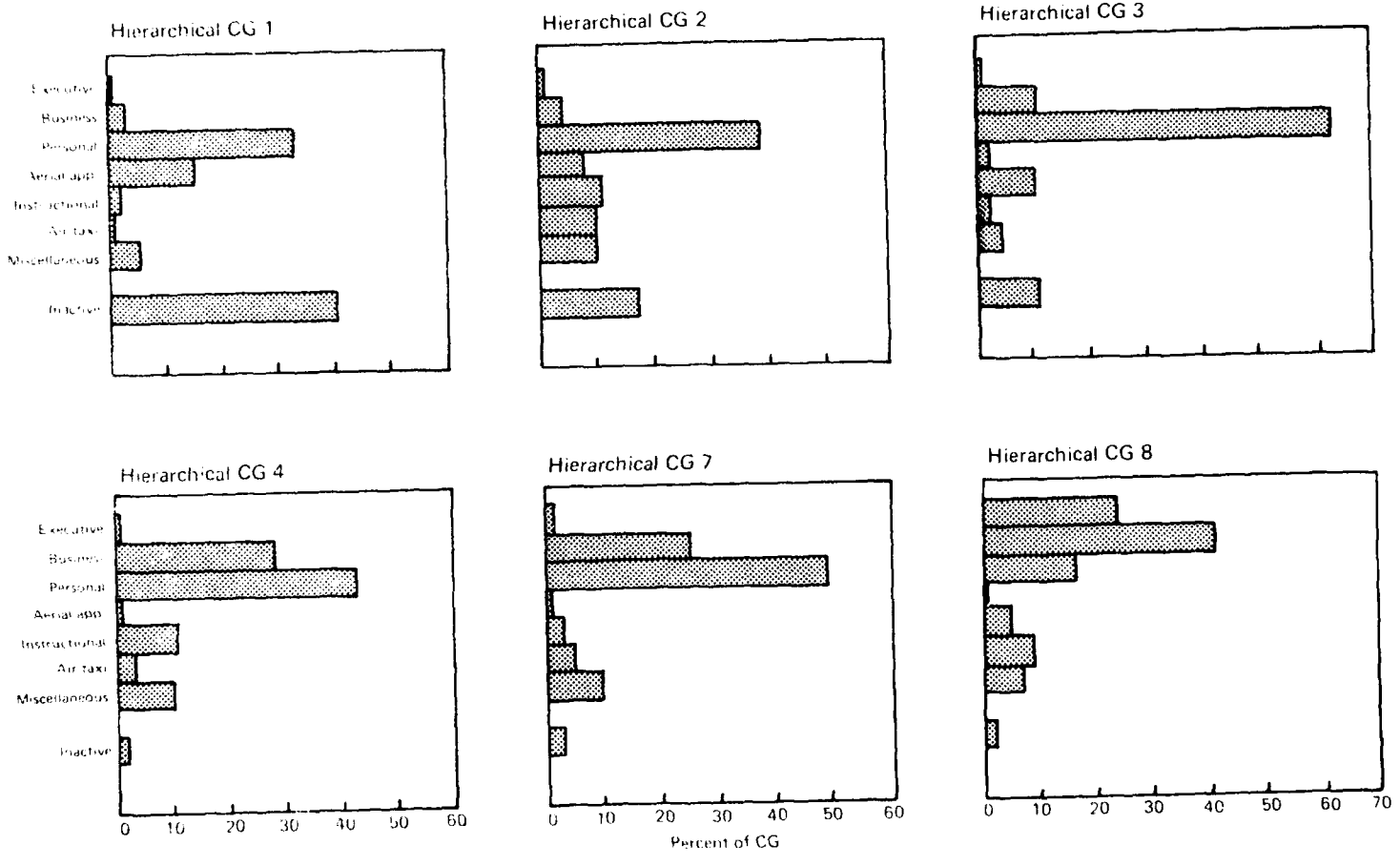
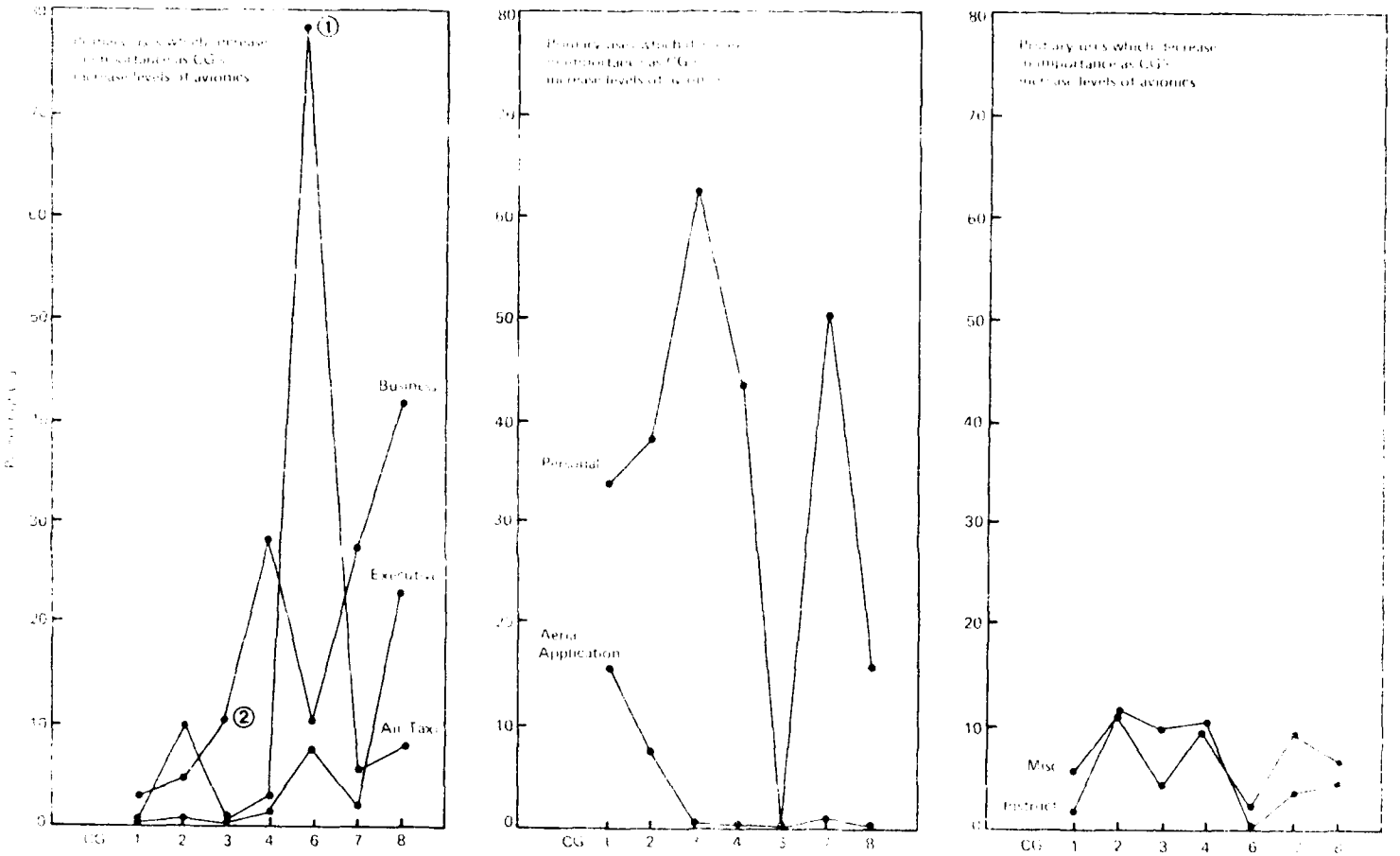


Figure 13. Percent Distribution of Hierarchical CG's by Primary Use



① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

② This point represents the percent of hierarchical CG 3 which have a primary use of business.

Figure 14. Primary Use Trends in Hierarchical CG's

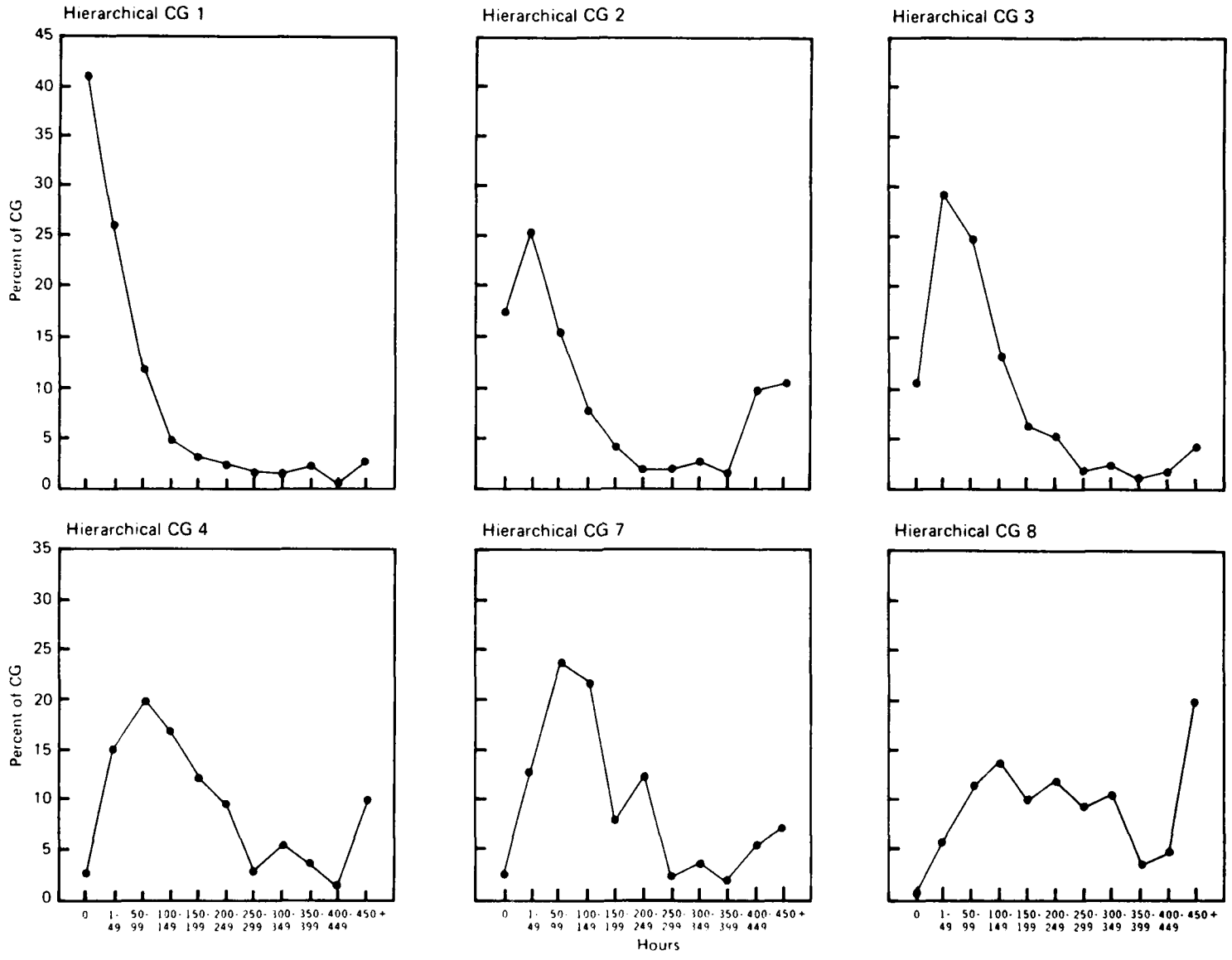


Figure 15. Percent Distribution of Hierarchical CG's by Annual Hours Flown

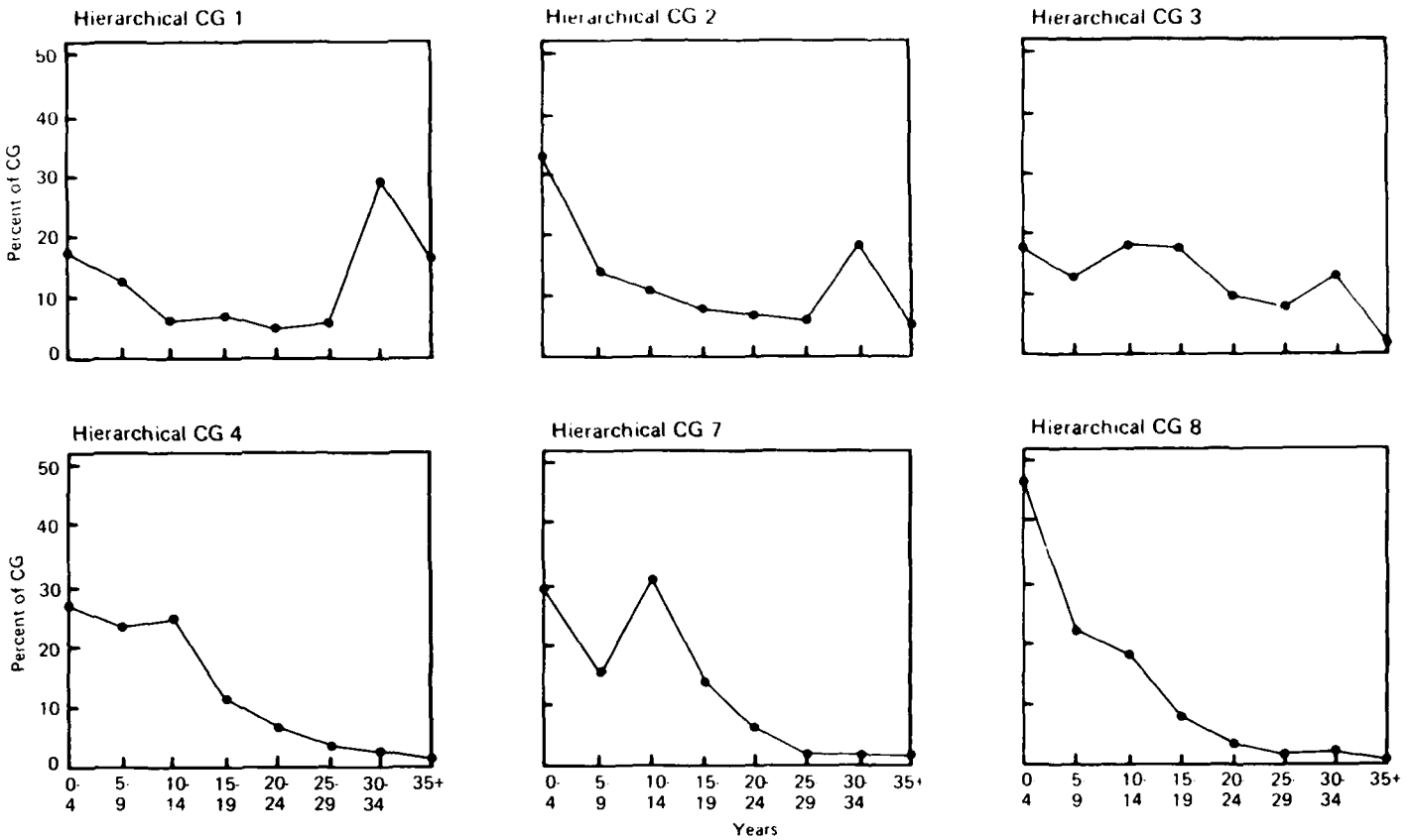


Figure 16. Percent Distribution of Hierarchical CG's by Age

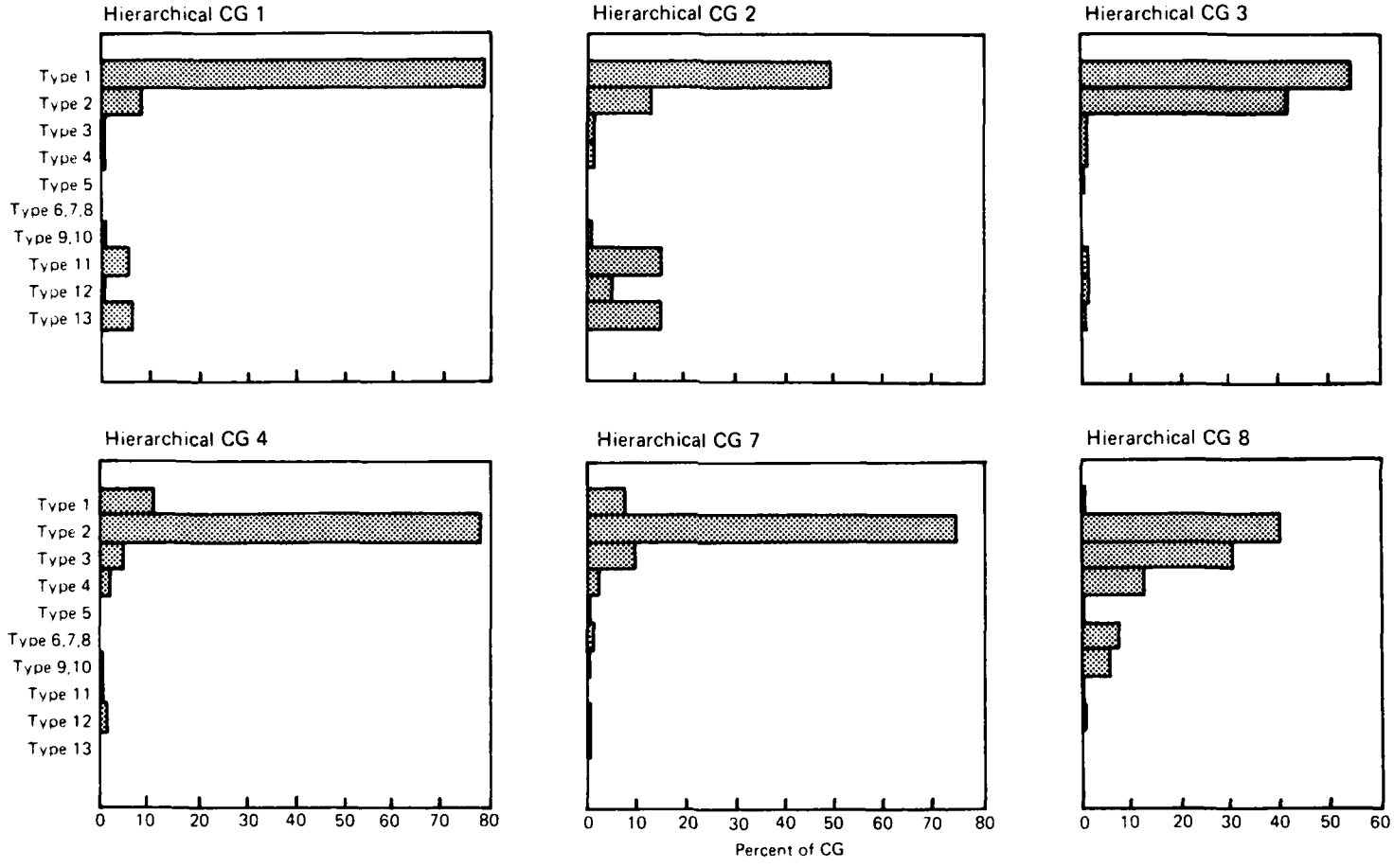
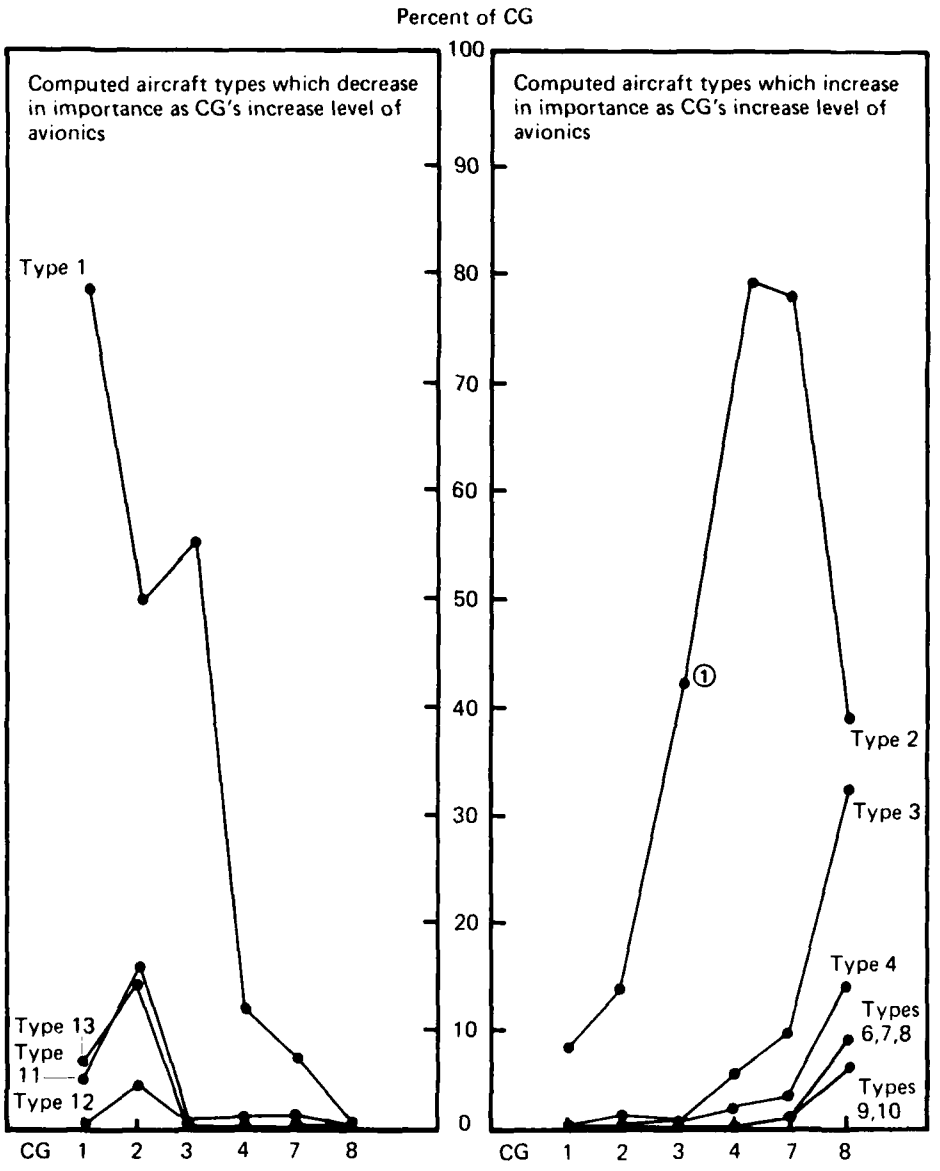
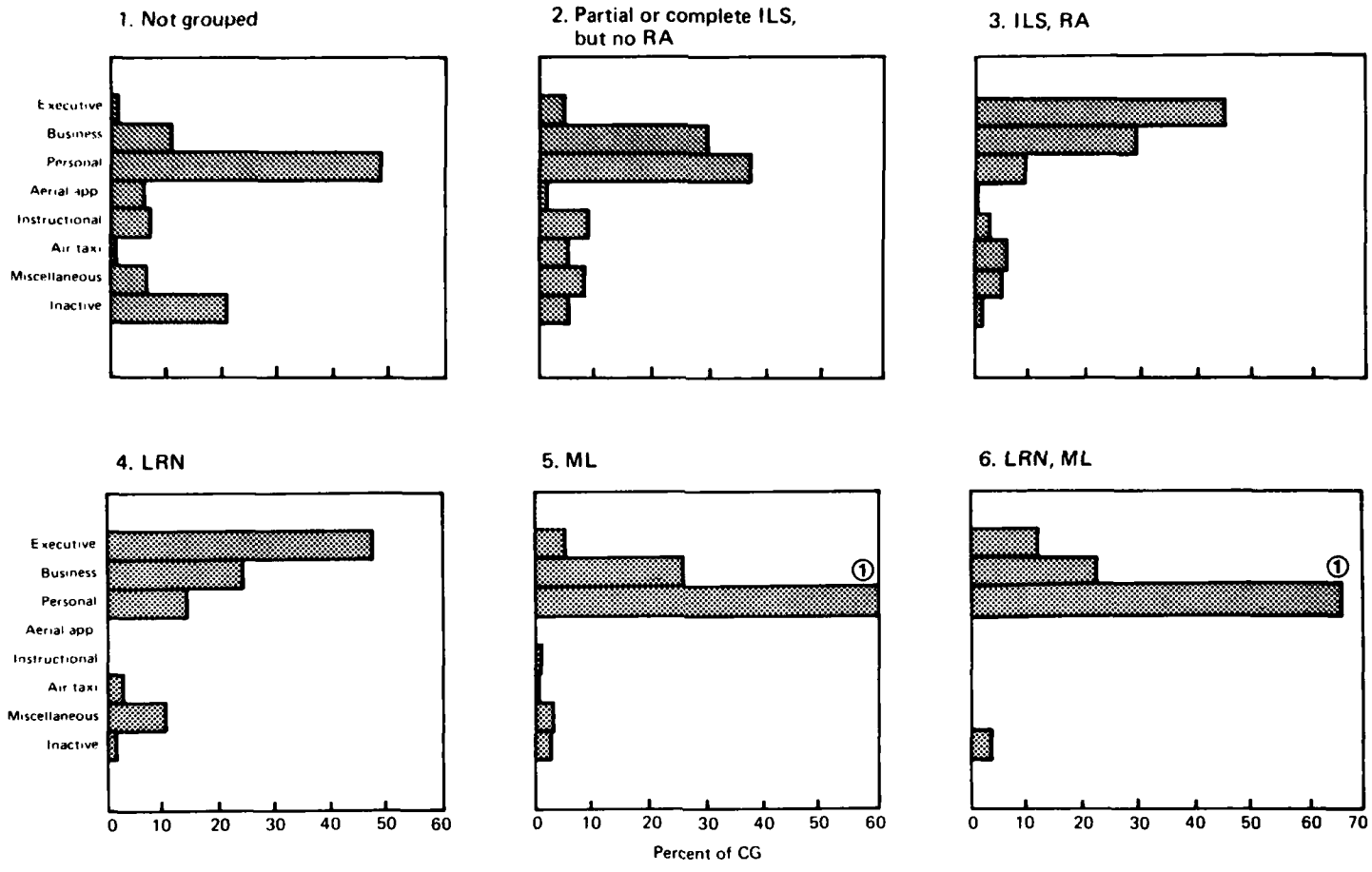


Figure 17. Percent Distribution of Hierarchical CG's by Computed Aircraft Type



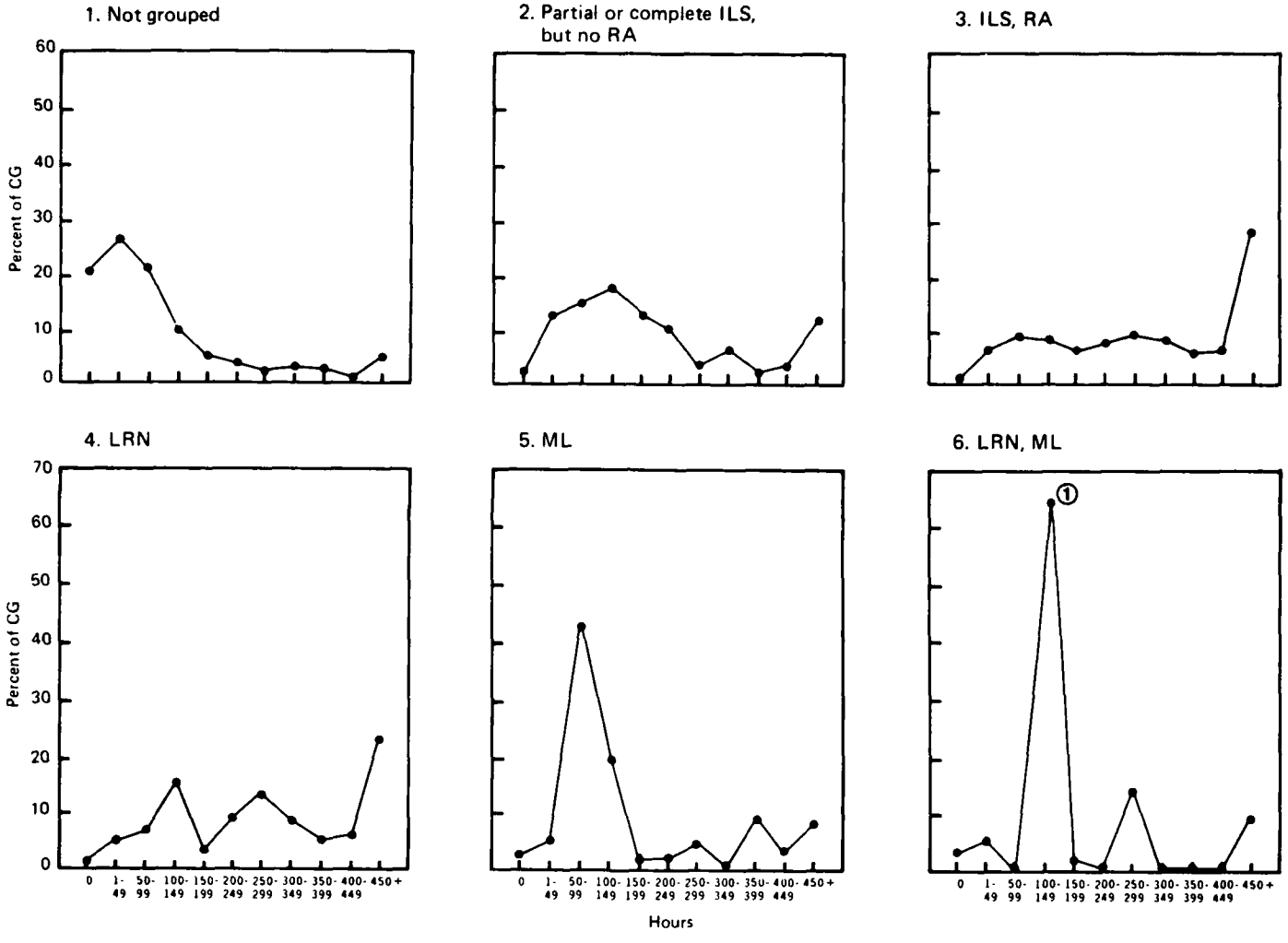
① This point represents the percent of hierarchical group 3 which are computed aircraft type 2, fixed wing single engine, piston 4+ seats.

Figure 18. Computed Aircraft Type Trends in Hierarchical CG's



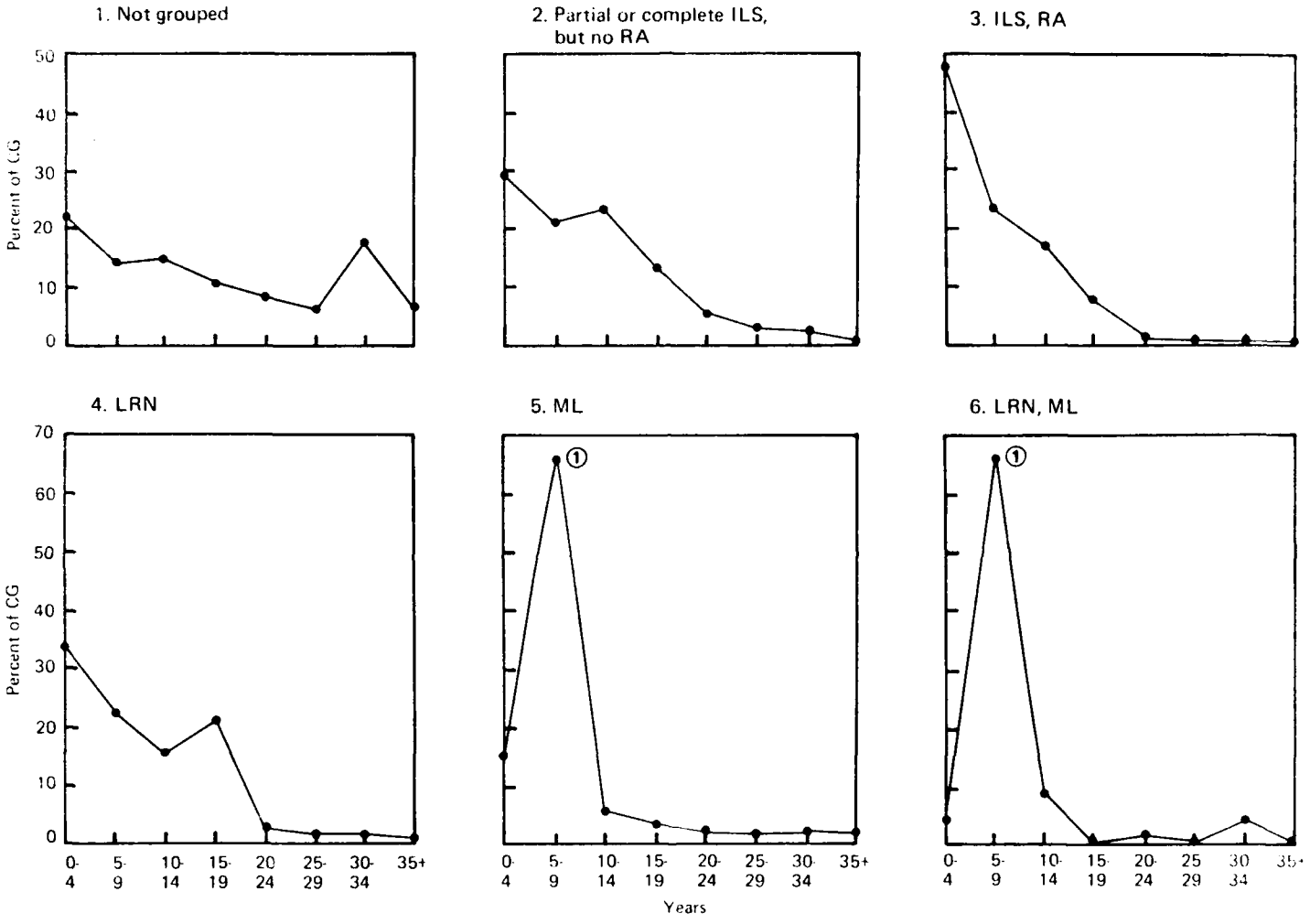
① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 19. Percent Distribution of Non-Hierarchical CG's by Primary Use



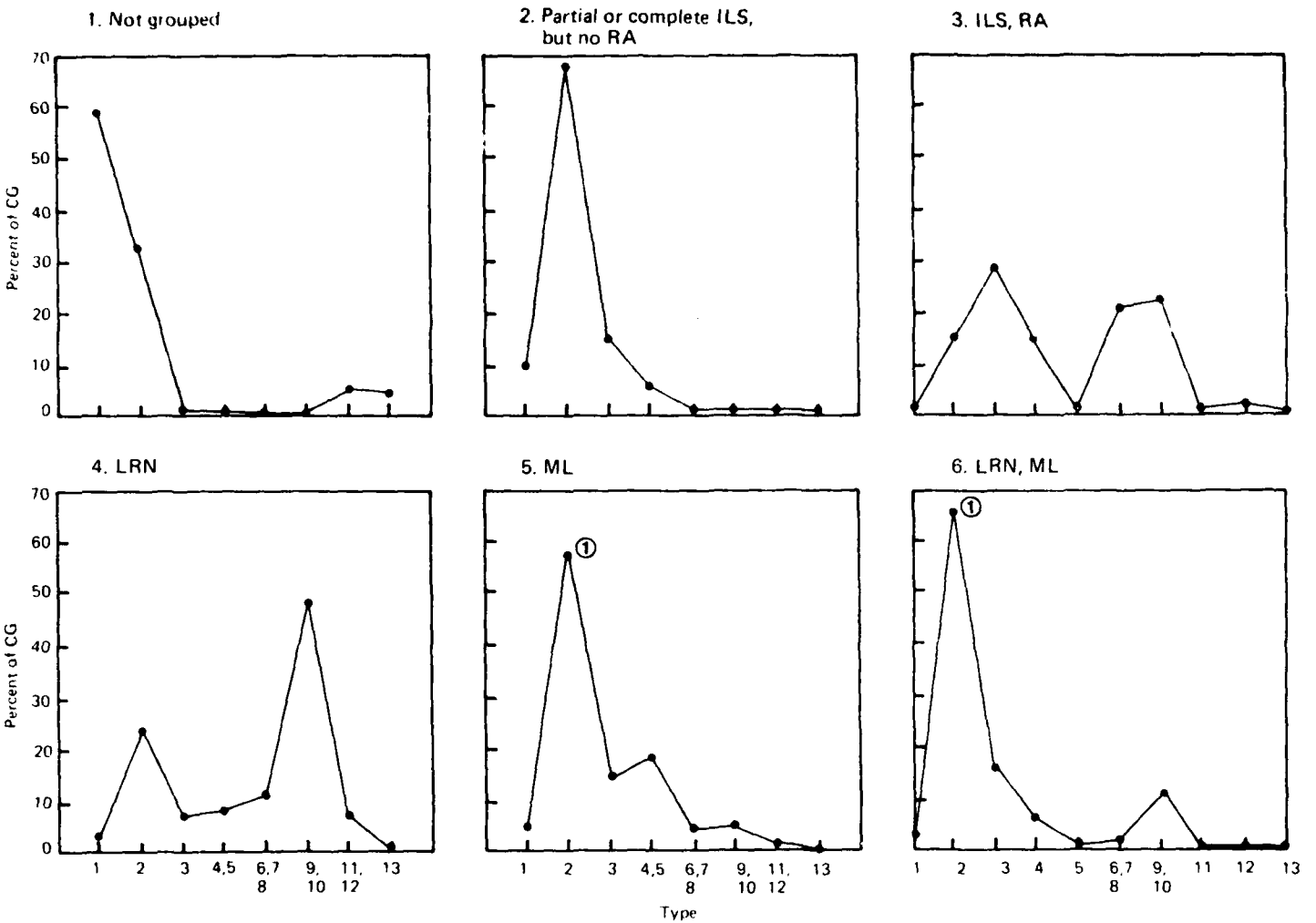
① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 20. Percent Distribution of Non-Hierarchical CG's by Annual Hours Flown



① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 21. Percent Distribution of Non-Hierarchical CG's by Age of Aircraft



① The 1977 figures are based on a sample survey rather than a census, therefore are subject to sampling error.

Figure 22. Percent Distribution of Non-Hierarchical CG's by Computed Aircraft Type

APPENDIX A

GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY DESIGN

APPENDIX A[1]

GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY DESIGN

1.0 SURVEY BACKGROUND

Prior to the current survey, the FAA used the Aircraft Registration Eligibility, Identification and Activity Report, FAA AC Form 8050-73 in its data collection program on general aviation activity and avionics. The form, sent annually to all owners of civil aircraft in the U.S., served two purposes: (1) Part I was the mandatory aircraft registration renewal form; (2) Part 2 was voluntary and applied to general aviation aircraft only, asking questions on the owner-discretionary characteristics of the aircraft such as flight hours, avionics equipment, base location, and use. In 1978, the FAA replaced AC Form 8050-73 with a new system: Part 1 was replaced by a triennial registration program; Part 2 was replaced by the General Aviation Activity and Avionics Survey, FAA Form 1800-54. (See Figure 1.) The survey was to be conducted annually based on a statistically selected sample of general aviation aircraft, requesting the same type of information as Part 2 of AC Form 8050-73. The first General Aviation Activity and Avionics Survey took place in 1978, collecting data on the 1977 GA aircraft fleet. Benefits resulting from the new method of data collection included quicker processing of the results, improved data quality, and a considerable savings in time and money to both the public and the Federal Government.

2.0 SURVEY COVERAGE

2.1 Aircraft

The General Aviation Activity and Avionics Survey covers, through a stratified probability sample, all general aviation aircraft registered in the United States.

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[1] Source: General Aviation Activity and Avionics Survey: 1977.

2.2 Geographic

The sample survey covers general aviation aircraft registered with the United States Aircraft Registry as of December 31, 1977. Over 99 percent of these aircraft are registered to owners living in the 50 states and Washington, D. C., with about 0.3 percent (543 aircraft) registered in Puerto Rico and other U.S. territories, and 0.2 percent (374 aircraft) registered to owners living in foreign countries.[1]

2.3 Content

Figure 1 is a copy of the survey questionnaire, FAA Form 1800-54. The questionnaire requests the owner to provide information on the sampled aircraft's characteristics and uses for various time periods:

1) Hours by use, IFR hours, fuel consumption, and leasing information for entire calendar year 1977,

2) Airframe hour reading and state of aircraft base as of December 31, 1977, and

3) Avionics equipment currently on board.

3.0 SAMPLE DESIGN

3.1 Sample Frame and Size

The Aircraft Registration Master File, maintained by the FAA Mike Monroney Aeronautical Center in Oklahoma City, provided the sample frame, the list of aircraft from which the sample was selected, for the survey. This file is the official record of registered civil aircraft in the U.S., containing one record per aircraft. It accurately represents the current civil air fleet, being updated continuously for new registrations, changes in ownership, etc.

All aircraft identified as general aviation in the file according to the definition in Section 1.1.1 comprise the sample frame with the following exceptions:

---

[1] Source: FAA Aircraft Registration Master File as of December 31, 1977.

1) Aircraft registered to dealers.

2) Aircraft with "Sale Reported" or "Registration Pending" appearing in the record instead of the owner's name.

3) Aircraft with a known inaccurate owner's address.

4) Aircraft with missing state of registration, aircraft make-model-series code, or aircraft type information.

For calendar year 1977, the sample frame consisted of 212,598 general aviation aircraft records from which 30,643 records were sampled, yielding a 14.4 percent sample. Table A1 shows the distribution of the sample compared to that of the population by aircraft type. Table A2 shows similar distributions by FAA region. (See Appendix C for the FAA regional map.) These displays clearly demonstrate the disproportionality of the sample to the population, an intended result of the sample design to gain efficiency and to control errors.

3.2 Description of Sample Design

The sample design employed was a stratified, systematic design from a random start. The sample was selected from a two-way stratified frame matrix. The two stratification criteria were:

1) State or territory of aircraft registration.

2) A variable called make-model index constructed from the thirteen aircraft types and the 300+ aircraft manufacturer/model groups of 20 or more general aviation aircraft.

The 54 levels of the state criterion and the 337 levels of the make-model index yielded a matrix of 54 by 337, or 18,198 cells (strata) among which the frame was divided for sampling.

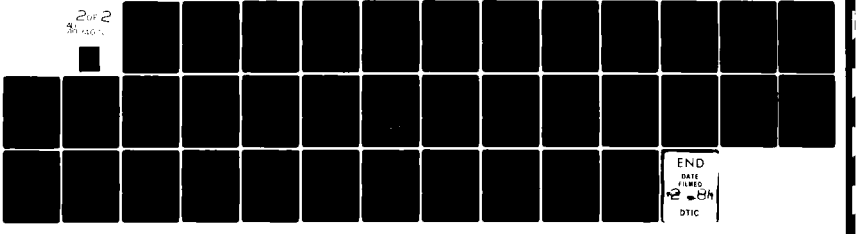
The FAA's primary requirement was for estimates of mean annual flight hours per aircraft, necessitating optimal determination of sample sizes based on flight hour variation within the cells, and not on cell size. Hence, the sample was not proportional to cell size, and a sampling fraction was determined for each cell with a non-zero popula-

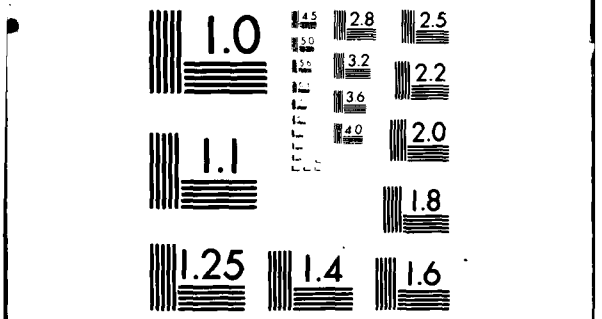
TABLE A1. SAMPLE AND POPULATION DISTRIBUTIONS BY AIRCRAFT TYPE

TYPE	POPULATON	SAMPLE SIZE	SAMPLE AS % OF POPULATION
Fixed Wing			
Piston			
1 Engine, 1-3 seats	74,455	13,709	18.4
1 Engine, 4+ seats	98,191	8,150	8.3
2 Engines, 1-6 seats	15,690	2,118	13.5
2 Engines, 7+ seats	7,161	1,654	23.1
Other Piston	353	235	66.1
Turboprop			
2 Engines, 1-12 seats	2,295	345	15.0
2 Engines, 13+ seats	581	110	18.9
Other Turboprop	98	85	86.7
Turbojet			
2 Engines	1,995	499	25.0
Other	499	310	62.1
Rotorcraft			
Piston	4,652	1,486	31.9
Turbine	2,193	438	20.0
Other	4,435	1,504	33.9
TOTAL	212,598	30,643	14.4

AD-A094 072 TRANSPORTATION SYSTEMS CENTER CAMBRIDGE MA F/G 1/2
GENERAL AVIATION AVIONICS STATISTICS: 1977.(U)
JUN 80 J C SCHWENK, P SHAFER, P PANDIT
UNCLASSIFIED TSC-FAA-80-13 FAA-MS-80-6 NL

2 OF 2
AD A094072





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

TABLE A2. SAMPLE AND POPULATION DISTRIBUTIONS BY REGION OF REGISTERED AIRCRAFT

REGION	APPROXIMATE POPULATION	SAMPLE SIZE	SAMPLE AS % OF POPULATION
Alaska	5,865	756	12.9
Central	15,650	2,457	15.7
Eastern	22,536	4,430	19.7
European (Foreign)	373	171	45.8
Great Lakes	38,272	3,818	10.0
New England	7,594	3,263	43.0
Northwestern	13,960	1,774	12.7
Pacific	539	342	63.5
Rocky Mountain	12,066	2,907	24.1
Southern	33,748	5,241	15.5
Southwestern	28,548	3,147	11.0
Western	33,447	2,337	7.0
TOTAL	212,598	30,643	14.4

tion. Sampling was then performed systematically from a random start within individual cells.

Initially, each aircraft in the sample was given a weight which was the inverse of its cell's sampling fraction, and which corresponded to the number of aircraft in the sample frame represented by that aircraft. When all responses to the survey were tallied, each weight was adjusted in two ways: one, according to the response rate for the aircraft's make-model index, and the other according to the response rate for the aircraft's state of registration, counting an aircraft for which no survey questions were answered as a non-respondent and an aircraft for which at least one question was answered as a respondent. The make-model index adjustment is described below; the state adjustment is analogous.

1) Non-respondents' weights were changed to zero.

2) The weights of all responding aircraft in make-model indices where there were fewer than five telephone follow-up contracts were adjusted uniformly by dividing the initial weight by the response rate.

3) In make-model indices where there were five or more telephone follow-up contacts, the weights of the mail respondents remained unchanged, and the weights of the telephone respondents were increased by dividing their initial weights by the proportion of non-respondents contacted by telephone.

This method of weight adjustment has several attributes. It actually incorporates the response rates into the final weights and simplifies estimation procedures. In addition, 3) above removes non-response bias from the affected make-model indices and states of registration by weighting the telephone sample of mail non-respondents to adjust for the remaining non-respondents. When calculating final estimates, the state weights are used for all state and regional estimates, the make-model index weights for all other estimates.

3.3 Error

Errors associated with estimates derived from sample survey results fall into two categories: sampling and non-sampling errors.[1] Sampling errors occur because the estimates are based on a sample - not the entire population. Non-sampling errors arise from a number of sources such as non-response, inability or unwillingness of respondents to provide correct information, differences in interpretation of questions, mistakes in recording or coding the data obtained, and others. The following sections discuss the two types of errors.

3.3.1 Sampling Error

In a designed survey, the sampling error associated with an estimate is generally unknown, but a measurable quantity known as the standard error is often used as a guide to the magnitude of sampling error. The standard error measures the variation which would occur among the estimates from all possible samples of the same design from the same population. It thus measures the precision with which an estimate approximates the average result of all possible samples or the result of a survey in which all elements of the population were sampled.

Through sample design techniques, the statistician can control the sizes of standard errors on a few key variables, known as design variables, in the survey. In the General Aviation Activity and Avionics Survey, the design variables were the mean annual hours flown per aircraft by aircraft type, by aircraft manufacturer-model group, and by state of aircraft registration. The sample was designed to produce standard errors on these variables at levels specified by the FAA. No controls were placed on the standard errors of the non-design variables.

Thus, every estimate resulting from a sample survey, whether it be for a design or non-design variable, has sampling error associated with it. The user of survey results must consider this error along with the point estimate itself when making inferences or drawing conclusions about the sample population. A large standard error

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[1] Standards for Discussion and Presentation of Errors in Data, U.S. Department of Commerce, Bureau of the Census, (Washington, DC., 1974), pp. 11-14.

relative to an estimate indicates lack of precision and, inversely, a small standard error indicates precision. To facilitate the comparison of estimates and their errors, the tables in Section 3 of this publication display the percent standard error divided by the corresponding estimate. The paragraphs below explain the proper interpretation and use of the errors.

An estimate and its standard error make it possible to construct an interval estimate with prescribed confidence that the interval will include the average value of the estimate from all possible samples of the population. Table A3 below shows selected interval widths and their corresponding confidence.

TABLE A3. CONFIDENCE OF INTERVAL ESTIMATES

WIDTH OF INTERVAL	APPROXIMATE CONFIDENCE THAT INTERVAL INCLUDES AVERAGE VALUE
1 Standard error	68%
2 Standard errors	95%
3 Standard errors	99%

As an example, from Table 8 a 95 percent confidence interval for the estimated number of aircraft in the 0-4 years age category would be 55695 ± 2(.041)(55695) or 55695 ± 4567 or (51128,60262). One would say that the number of aircraft in the 0-4 years age category lies somewhere between 51128 and 60262 with 95 percent confidence.

3.3.2 Non-Sampling Error

Non-sampling error can be reduced through survey design, although the amount of reduction is difficult, if not impossible, to quantify in any given design. Nevertheless, through controlled experiments, various techniques have been identified which limit non-sampling error. Several of these techniques were incorporated into the design of the general aviation survey and are itemized below:

- The second mailing and telephone survey of a sample of non-respondents were conducted in addition to the original mailing to improve the response rate, since a low response rate is a major cause of non-sampling error. 80 percent of those aircraft sampled responded to at least one question of the survey; this compares favorably with the expected response rate of 80 percent used in determining the overall sample size initially. Tables A4 and A5 show the response rates broken down by FAA region and aircraft type, respectively. The lowest response rate for any region was 50 percent for the European (Foreign) Region due to mail delivery and telephone contact difficulties. The Pacific Region rate was low at 65 percent for similar reasons. These two regions, however, represented less than 0.5 percent of the active U.S. general aviation fleet. Other Turboprop had the lowest response rate at 60 percent of any of the aircraft types, but these aircraft represented less than 0.1 percent of the fleet.

- The telephone sample of mail non-respondents also helped to minimize bias in results caused by differences in attributes between respondents and non-respondents.

- The survey questionnaire was designed and tested to minimize misinterpretation of questions by the aircraft owners.

- To assure the owners of the confidentiality of their responses, the questionnaire cover letter informed them that the intended use of the responses was for "producing summary statistics and not to disclose individual operations nor to make corrections to your aircraft records."

- Comprehensive editing procedures insured the accuracy of the data transcription to machine readable form and the internal consistency of responses.

- The most accurate source of information on the general aviation fleet, the FAA Aircraft Registration Master File, was used as the sampling frame.

TABLE A4. RESPONSE RATE BY REGION

REGION	RESPONSE RATE (%)	REGION	RESPONSE RATE (%)
Alaskan	71	Pacific	65
Central	81	Rocky Mountain	80
Eastern	82	Southern	79
European (Foreign)	50	Southwestern	78
Great Lakes	83	Western	78
New England	84		
Northwestern	80	TOTAL	80

TABLE A5. RESPONSE RATES BY AIRCRAFT TYPE

AIRCRAFT TYPE	RESPONSE RATE (%)	AIRCRAFT TYPE	RESPONSE RATE (%)
Fixed Wing		Turbojet	
Piston			
1 eng. 1-3 seats	82	2 Eng.	82
1 eng. 4 + seats	80	Other	70
2 eng. 1-6 seats	76		
2 eng. 7 + seats	72		
Other	72		
Turboprop		Rotorcraft	
2 eng. 1-12 seats	80	Piston	80
2 eng. 13 + seats	86	Turbine	82
Other	60	Other	81
		TOTAL	80

4.0 SURVEY METHOD

The main method of collecting data for this survey was the mail questionnaire, sent to the owners of the sampled aircraft in two mailings. The first mailing on February 15, 1978, covered all 30,643 aircraft in the sample and had a response rate of 65 percent. This was about 82 percent of the total responses to the survey. The second mailing conducted on March 29, 1978, included only those aircraft in the sample that had not yet responded. The second mailing had a response rate of 35 percent which accounted for 15 percent of the total responses to the survey. The combined response rate for the two mailings was 78 percent of the sample.

A telephone follow-up survey was conducted during May and early June using the same questions appearing in the mail survey. A sample of the mail non-respondents was selected for the telephone survey weighing most heavily those states and make-model groups in the sampling strata that had the lowest mail response rates. Of a total telephone sample of 2289 aircraft, only 741, or 32 percent, responses could be obtained due to difficulty in obtaining telephone numbers, finding owners at home, and obtaining cooperation of owners over the telephone. Nevertheless, the 741 telephone responses contributed the remaining three percent of the responses and increased the overall response rate of the survey to 80 percent. (See Table A6.)

TABLE A6. SUMMARY OF RESPONSE INFORMATION BY SURVEY PHASE

SURVEY PHASE	SAMPLE SIZE (S)	NUMBER OF RESPONSES (R)	RESPONSE RATE (R/S x100%)	PORTION OF TOTAL RESPONSE (R/TOTAL R) x 100%
FIRST MAILING	30,643	20,008	65%	82%
SECOND MAILING	10,641	3,749	35%	15%
COMBINED MAILINGS	30,643	23,751	78%	97%
TELEPHONE SURVEY	2,289	741	32%	3%
TOTAL	30,643	24,498	80%	100%

APPENDIX B

SAMPLE FILE AIRCRAFT RECORD LAYOUT

Data Element	Field Description/Length	Position	Comments
1. Blank	A/N7	1-7	
2. Control Number	N6	8-13	Unique for each sampled aircraft. Data verification purposes only.
3. Blank	A/N20	14-33	
4. Aircraft manufacturer/model/series code	N7	34-40	Standard FAA numeric code.
5. Aircraft category code	N1	41	1 - Land 2 - Sea 3 - Amphibian
6. Aircraft type code	N1	42	1 - Glider 2 - Balloon 3 - Blimp/Dirigible 4 - Fixed Wing Single Engine 5 - Fixed Wing Multi-Engine 6 - Rotorcraft
7. Engine type code	N1	43	1 - Reciprocating 2 - Turbopropeller 3 - Turboshaft 4 - Turbojet 5 - Turbine Air Generator 6 - Ram Jet 9 - Unknown
8. Engine manufacturer/model code	N5	44-48	Standard FAA numeric code.
9. Number of engines	N2	49-50	

Data Element		Field Description/Length	Position	Comments
10.	Engine Horsepower	N5	51-55	Per engine
11.	Year of manufacture	N2	56-57	00 if unknown
12.	Registrant type	N1	58	1 - Individual 2 - Partnership 3 - Corporation 4 - Co-ownership 5 - Government
13.	Number of co-owners	N2	59-60	Does not include principal owner.
14.	Aircraft base state numeric code	N2	61-62	
15.	Aircraft base region code	A/N1	63	
16.	Engine SDR group name	A/N12	64-75	Standard FAA numeric code.
17.	Final Weight-state	N6	76-81	Weight used when compiling state or regional statistics.
18.	Blanks	A/N48	82-129	
19.	Registrant City	A/N18	130-147	
20.	Registrant Zip code	N5	148-152	
21.	Registrant region	A/N1	153	
22.	Registrant state code	N2	154-155	
23.	Registrant country code	N3	156-158	

Data Element	Field Description/Length	Position	Comments
24. Airworthiness class	N1	159	1 - Standard 2 - Limited 3 - Restricted 4 - Experimental 5 - Provisional 6 - Multiple 8 - Special Flight Permit
25. Certificate issue date	N6	160-165	
26. State abbreviation	A/N2	166-167	Standard Postal Abbreviations
27. Aircraft manufacturer name	A/N30	168-197	Standard FAA name.
28. Aircraft model name	A/N20	198-217	Standard FAA name.
29. Number of seats	N3	218-220	
30. Respondent type	N1	221	1 - Respondent to First Mailout 2 - Respondent to Second Mailout 3 - Respondent to Telephone Survey 5 - Address Unknown 6 - Non-respondent
31. GA/air carrier indicator	N1	222	0 for GA.
32. Lifetime airframe hours	N5	223-227	
33. Active/inactive	N1	228	0, if not reported; 1, if active; 2, if inactive.

Data Element	Field Description/Length	Position	Comments
34. Owned part of year	N1	229	0, if owned full year; 1, if owned part of year.
35. Executive use hours	N4	230-233	These hours contain both current and previous owners' hours.
36. Business use hours	N4	234-237	
37. Personal use hours	N4	238-241	
38. Aerial application hours	N4	242-245	
39. Instructional use hours	N4	246-249	
40. Air taxi hours	N4	250-253	
41. Industrial/ special use hours	N4	254-257	
42. Rental use hours	N4	258-261	
43. Other use hours	N4	262-265	
44. Annual hours flown	N4	266-269	Sum of Fields 35 through 43 inclusive.
45. Primary use	N1	270	Ø - Unknown or inactive 1 - Executive 2 - Business 3 - Personal 4 - Aerial application 5 - Instruction 6 - Air taxi 7 - Industrial/special 8 - Aircraft rental business 9 - Other

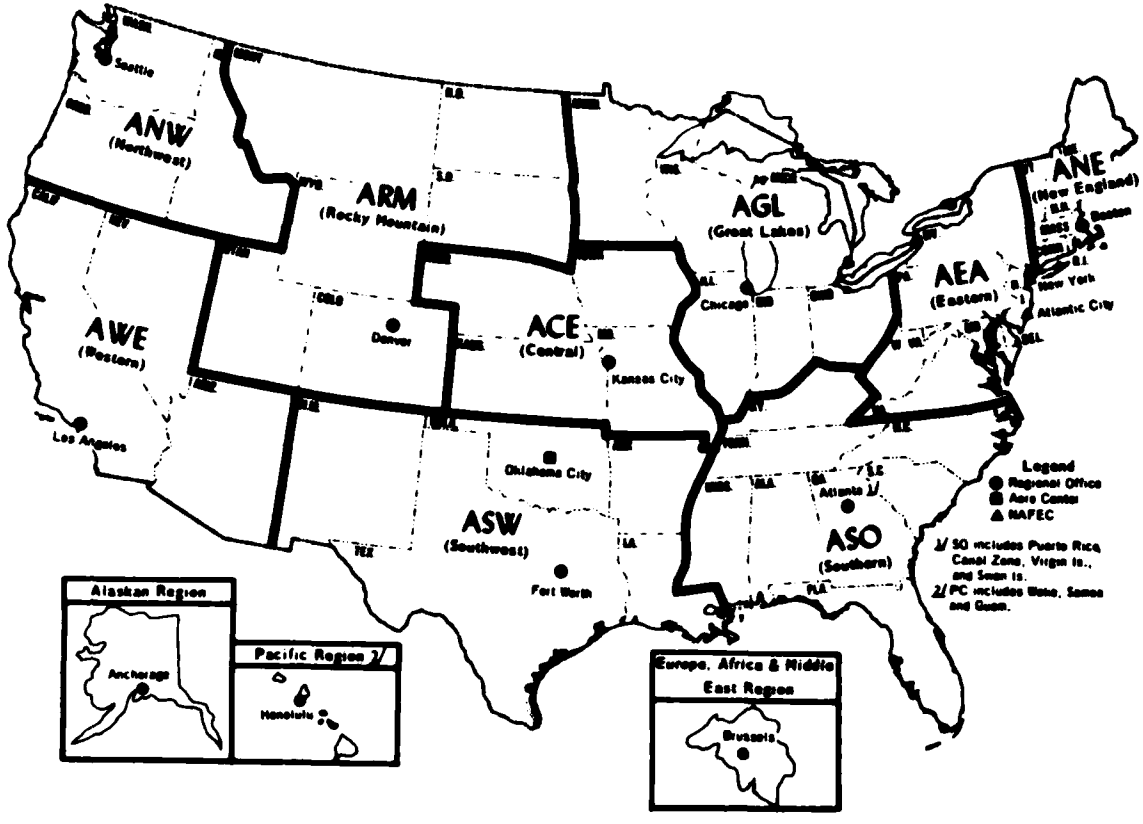
Data Element	Field Description/Length	Position	Comments
46. IFR flight	N1	271	0, if not reported; 1, if not flown IFR; 2, if flown IFR.
47. IFR hours	N4	272-275	
48. Fuel consumption	N4	276-279	Gallons per hour for the aircraft.
49. Aircraft base state abbreviation	A/N2	280-281	Standard Postal Abbreviation
50. Leased during year	N1	282	0, if not reported 1, if leased 2, if not leased
51. VHF: 360 channels or less	N1	283	
52. VHF: 720 channels or more	N1	284	
53. VHF: more than one	N1	285	
54. No VHF	N1	286	0, if not checked 1, if checked
55. 4096 code transponder	N1	287	
56. Altitude encoding equipment	N1	288	
57. No transponder equipment	N1	289	
58. VOR: 100 channels	N1	290	

Data Element		Field Description/Length	Position	Comments
59.	VOR: 200 channels	N1	291	
60.	VOR: more than one receiver	N1	292	
61.	ADF	N1	293	
62.	DME	N1	294	
63.	RNAV	N1	295	
64.	Long range RNAV	N1	296	
65.	Auto pilot	N1	297	
66.	Radar altimeter	N1	298	0, if not checked; 1, if checked.
67.	Weather radar	N1	299	
68.	No navigation equipment	N1	300	
69.	Localizer	N1	301	
70.	Marker beacon	N1	302	
71.	Glide slope	N1	303	
72.	MLS	N1	304	
73.	No ILS equipment	N1	305	
74.	Computed aircraft type	N2	306-307	See Table 4.

Data Element	Field Description/Lenght	Position	Comments
75. Final weight make-model	N6	308-313	
76. Manufacturer/ model/type index	N3	314-316	A unique number for each make-model index level of stratification criterion 2.
77. Aircraft SDR group name	A/N12	317-328	Standard FAA name.

APPENDIX C

FEDERAL AVIATION ADMINISTRATION REGIONAL MAP



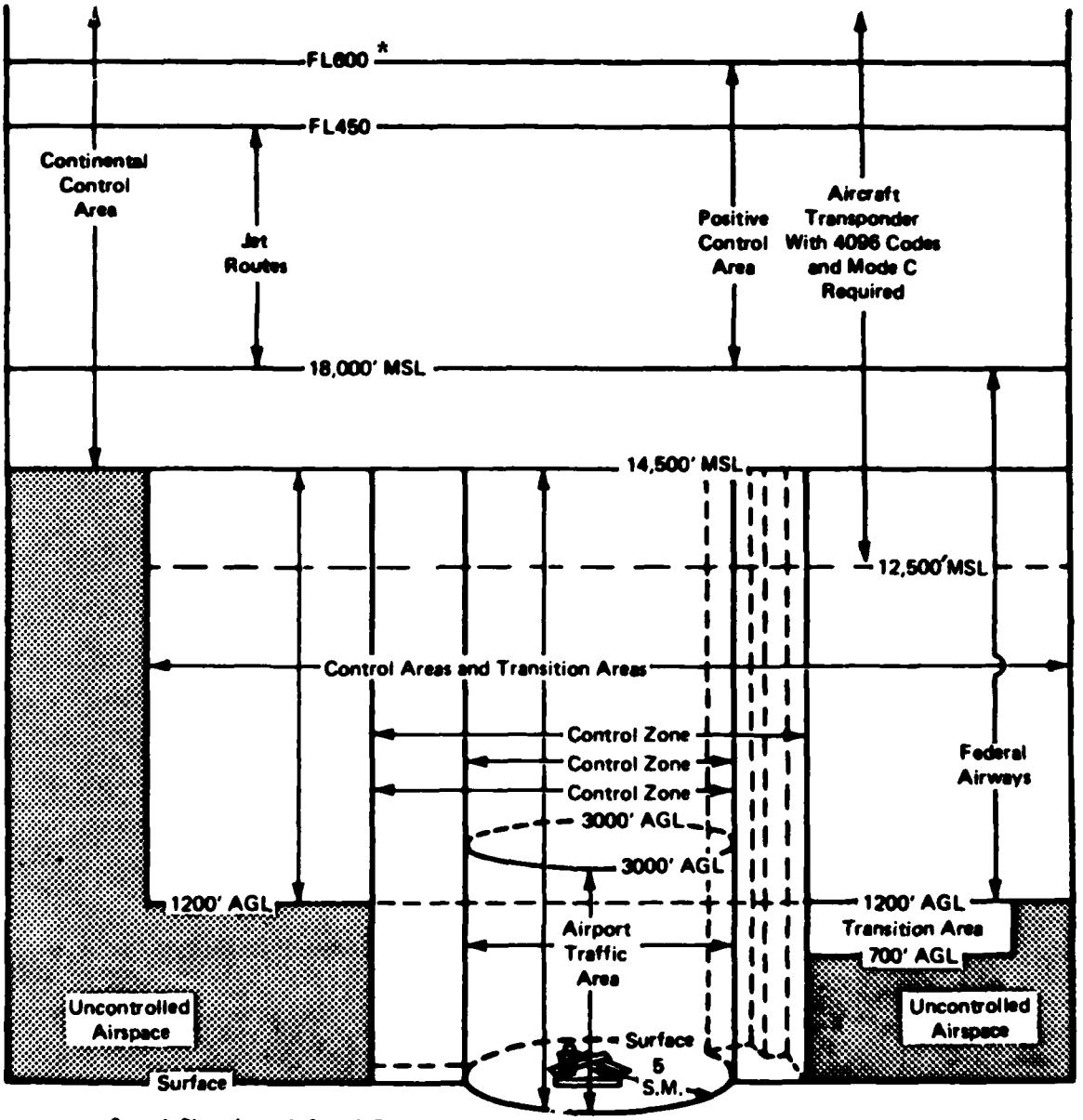
FAA Air Traffic Activity Calendar Year 1977, (March 1977), p. 10

FEDERAL AVIATION ADMINISTRATION REGIONAL MAP AS OF JUNE 30, 1977

APPENDIX D

AIRSPACE STRUCTURE

APPENDIX D. AIRSPACE STRUCTURE



General Dimensions of Control Zones, Airport Traff. Areas, and the Vertical Extent of Airspace Segments.

* FL600 means "Flight Level 60,000 feet MSL"

Airman's Information Manual, Basic Flight Manual and ATC Procedures, Part 1, (May, 1976), p. 1-23.

APPENDIX D (CONTINUED)

WEATHER CATEGORY DEFINITIONS[1]

Category	Definition (Ceiling in ft., Visibility in mi.)
VFR	≥1500 ft.[2] and 3 mi.
IFR 0	<1500 ft. and/or 3 mi., but ≥ 400 ft. and 1 mi.
IFR I	< 400 ft. and/or 1 mi., but ≥ 200 ft. and 1/2 mi.
IFR II	< 200 ft. and/or 1/2 mi., but ≥ 100 ft. and 1/4 mi.
IFR III	< 100 ft. and/or 1/4 mi.

[1] Ceiling-Visibility Climatological Study and Systems Enhancement Factors (Washington, 1975), p. 15.

[2] This altitude may vary depending on the minimum approach altitude for the airport.

APPENDIX D, (CONTINUED)

Summary of Major Airspace Designated Areas

Designation	Measure	Present system 1975	Future system	
			In plan 1976–85	Total 1985
En route:				
Jet routes	Number	216	−66	150
Jet area navigation routes	Number	163	+47	200
Low altitude routes:				
Low frequency	Number	24	−24	0
VHF/UHF	Number	462	−214	248
Area navigation VHF	Number	8	+192	200
Area positive control	Altitude (FL)			
Conterminous U.S.		180–600	——	180–600
Alaska		240–600	——	240–600
Parallel	Number	0	+500	500
Three dimensional	Number	0	+1000	1000
Terminal:				
Control zones	Number	806	+287	1093
Transition areas	Number	1,495	−9	1486
Control area extension	Number	1	——	1
Terminal control areas (Group I & II)	Number	18	3	21
STARs/SIDs	Number	414	−239	175
RNAV STARs/SIDs	Number	2	+448	450
Special use:				
Prohibited areas	Number	7	+2	9
	Square Miles	1,626	——	——
Restricted areas	Square Miles	77,639	——	——
Joint use	Number	163	+6	169
Nonjoint use	Number	29	−18	11
Warning areas	Number	68	−33	35
	Square Miles	408,970	——	——
Alert areas	Number	35	−5	30
Jet training areas	Number	35	−5	30
	Square Miles	87,183	——	——

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-3.

APPENDIX D. (CONTINUED)

Airborne Equipment Requirements

Types of Airspace	Flight condition	Equipment Requirements	
		1975	1985
Uncontrolled	VFR (day)	1. Airspeed indicator 2. Altimeter 3. Compass 4. Tachometer 5. Oil temperature 6. Emergency locator transmitter [1] 7. Manifold pressure 8. Fuel gage 9. Landing gear 10. Belts 11. Special equipment for over water flights (FAR 91.33)	Same as 1975
Uncontrolled	VFR (night)	All above plus: 1. Position lights 2. Anti-collision light 3. Landing light (if for hire) 4. Electrical source	Same as 1975
Uncontrolled	IFR	Same as VFR plus: 1. Two-way radio 2. Navigation system 3. Gyro turn/bank 4. Sensitive altimeter adjustable for barometric pressure 5. Clock with sweep second hand 6. Artificial horizon 7. Directional gyro or equivalent 8. Generator	Same as 1975
Controlled (non-positive)	VFR	Same as uncontrolled VFR plus transponder [2]	Same as 1975
	IFR	Same as uncontrolled IFR plus transponder [2]	Same as 1975
Positive control	VFR	Requires prior ATC approval	Same as 1975
	IFR	Same as uncontrolled IFR plus: 1. DME (if VOR/TACAN equipment carried) 2. Transponder [2] 3. VOR (In TCA's) 4. ADF (Air Carrier only) 5. ILS (Air Carrier only)	Same as 1975

[1] Does not apply to turbojet aircraft, scheduled air carriers (except charter), or certain training and agricultural flights.

[2] 4096 code, Mode 3A transponder with Mode C automatic altitude reporting capability will be required at Group I and II TCA Locations and in APC, and in controlled airspace of the 48 States above 12,500 feet. All non-participating aircraft operating within Group III TCA's will be transponder equipped with Mode C capability.

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 13-5.

APPENDIX D. (CONTINUED)

National Terminal Radar Programs

Location	Terminal airspace designation	Equipment Requirements		Services provided
		Present	Under Consideration	
Top 9 Large Hub locations.	Group I TCA	(Effective Jan 1. 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability; Two-way Radio; VOR or TACAN Receiver.	Relaxation of Transponder Requirements During Periods of Low Activity.	TCA Procedures
Next 12 Large Hub locations	Group II TCA	(Effective July 1, 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability; Two-way Radio; VOR or TACAN Receiver.	Deletion of Altitude Encoding Requirement. (Has been deleted)	TCA Procedures
Remaining 42 ARTS-III locations.	Group III TCA	(Effective July 1, 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability *or* Two-way Radio Communications.		TCA Procedures
All other radar facilities	TRSA where Stage III service is provided	----------		Stage II or III service

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-4.

APPENDIX D. (CONCLUDED)

Designated Terminal Airspace (All ARTS-III Locations); Terminal Control Areas

GROUP I	Date designated or planned	GROUP II	Date designated or planned
1. Atlanta	June 1970	1. St. Louis	Jan. 1974
2. Chicago	Aug. 1970	2. Seattle	Jan. 1974
3. Washington National	Feb. 1971	3. Minneapolis	Feb. 1974
4. New York (LGA, JFK, EWR)	Sept. 1971	4. Denver	Mar. 1974
5. Los Angeles	Sept. 1971	5. Houston	Mar. 1974
6. San Francisco	Dec. 1972	6. Cleveland	May 1974
7. Boston	Feb. 1973	7. Detroit	May 1974
8. Miami	Apr. 1973	8. Pittsburgh	May 1974
9. Dallas	Jan. 1974	9. Las Vegas	Nov. 1974
		10. Philadelphia	Mar. 1975
		11. Kansas City	Mar. 1975
		12. New Orleans	Jul. 1975

Group III Terminal Areas (42 locations)

Albany	El Paso	Omaho	San Diego
Albuquerque	Hartford	Orlando	San Juan
Baltimore	Honolulu	Portland, Oreg.	Santa Ana/Long Beach
Birmingham	Indianapolis	Phoenix	Shreveport
Buffalo	Jacksonville	Providence	Syracuse
Burbank	Louisville	Raleigh-Durham	Tampa
Charlotte	Memphis	Ontario, California	Tucson
Cincinnati	Milwaukee	Rochester, N.Y.	Tulsa
Columbus, Ohio	Nashville	Sacramento	Washington-Dulles
Dayton	Norfolk	Salt Lake City	
Des Moines	Oklahoma City	San Antonio	

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-5.

GLOSSARY*

Aerial Application - Aerial application in agriculture consists of those activities that involve the discharge of materials from aircraft in flight and a miscellaneous collection of minor activities that do not require the distribution of any materials.

Air Carrier - The term "Air Carrier", as used in this report, refers to aircraft operators certified by the Federal Aviation Administration for the transportation by air of persons property, and mail.

Air Carrier Operations - Aircraft operations under certificates of public convenience and necessity, issued by the CAB, authorizing the performance of scheduled air transportation over specified routes and a limited amount of nonscheduled operations.

Airport Advisory Area - The area within five statute miles of an airport not served by a control tower, i.e., there is no tower or the tower is not in operation, on which is located a Flight Service Station.

Airport Traffic Area - Unless otherwise specifically designated in FAR Part 93, that airspace within a horizontal radius of 5 statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 feet above the elevation of the airport. Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at, or taking off from, an airport within that area. ATC authorization may be given as individual approval of specific operations or may be contained in written agreements between airport users and the town concerned. (Refer to FAR Parts 1 and 91.)

Airport Traffic Control Tower - A central operations facility in the terminal air traffic control system, consisting of tower cab structure, including an associated common IFR room if radar equipped, using air/ground communications and/or radar, visual signalling and other devices, to provide safe and expeditious movement of terminal air traffic.

*These definitions have been taken from the following three sources: Airman's Information Manual, Part 1, Census of U.S. Civil Aircraft, Calendar Year 1977, and FAA Air Traffic Activity, Calendar Year 1977.

Air Taxi Operations - Air Taxi operations (takeoff and landings) carry passengers, mail or cargo for revenue in accordance with FAR Part 135.

Airway/Federal Airway - A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. (Refer to FAR Part 7.)

Altitude - The height of the level, point or object measured in feet Above Ground Level (AGL) or from Mean Sea Level (MSL).

1. MSL Altitude - Altitude, expressed in feet measured from mean sea level

2. AGL Altitude - Altitude, expressed in feet measured above ground level.

3. Indicated Altitude - The altitude as shown by an altimeter. On a pressure or barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

Area Navigation/RNAV - A method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability. (Refer to FAR Part 71.)

a. Area Navigation Low Route - An area navigation route within the airspace extending upward from 1,200 feet above the surface of the earth to, but not including, 18,000 feet MSL.

b. Area Navigation High Route - An area navigation route within the airspace extending upward from and including 18,000 feet MSL to flight level 450.

c. Random Area Navigation Routes/Random RNAV Routes - Direct routes, based on area navigation capability, between waypoints, defined in terms of degree/distance fixes or offset from published or established routes/airways at specified distance and direction.

d. RNAV Waypoint/W/P - A predetermined geographical position used for route or instrument approach definition or progress reporting purposes that is defined to a VORTAC station position.

Automatic Altitude Reporting - That function of a transponder which responds to Mode C interrogations by transmitting the aircraft's altitude in 100-foot increments.

Automatic Direction Finder/ADF - An aircraft radio navigation system which senses and indicates the direction to a L/MF nondirectional radio beacon (NDB) ground transmitter. Direction is indicated to the pilot as a magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft depending on the type of indicator installed in the aircraft. In certain applications, such as military, ADF operations may be based on airborne and ground transmitters in the VHF/UHF frequency spectrum.

Balloon - A lighter-than-air aircraft that is not engine driven.

Business Transportation - Any use of an aircraft not for compensation or hire by an individual for the purpose of transportation required by a business in which he is engaged.

Certificated Pilot - A person who holds a certificate issued by FAA, which qualifies him to operate aircraft within the limitations prescribed on the certificate.

Colored (L/MF) Airway - Low altitude airway over the state of Alaska predicated on L/MF navigation aids. It is depicted on aeronautical charts by color and number.

Continental United States - The 49 states located on the continent of North America and the District of Columbia.

Conterminous U.S. - The forty-eight adjoining states and the District of Columbia.

Controlled Airport - An airport at which a control tower is in operation.

Controlled Airspace - Airspace, designated as a continental control area, control area, control zone, terminal control area, or transition area, within which some or all aircraft may be subject to air traffic control (Refer to FAR Part 71.)

Types of U.S. Controlled Airspace:

a. Continental Control Area - The airspace of the 48 contiguous states, the District of Columbia and Alaska, excluding the Alaska peninsula west of Long. 160 00'00"W at and above 14,500 MSL, but does not include:

   1. The airspace less than 1,500 feet above the surface of the earth or,

   2. Prohibited and restricted areas, other than the restricted areas listed in FAR Part 71.

b. Control Area - Airspace designated as Colored Federal Airways, VOR Federal Airways, Terminal Control Areas, Additional Control Areas, and Control Area Extensions, but not including the Continental Control Area. Unless otherwise designated, control areas also include the airspace between a segment of a main VOR airway and its associated alternate segments. The vertical extents of the various categories of airspace contained in control areas are defined in FAR Part 71.

c. Control Zone - Controlled airspace which extends upward from the surface and terminates at the base of the continental control area. Control zones that do not underlie the continental area have no upper limit. A control zone may include one or more airports and is normally a circular area within a radius of 5 statute miles and any extensions necessary to include instrument approach and departure paths.

d. Terminal Control Area/TCA - Controlled airspace extending upward from the surface or higher to specified altitudes within which all aircraft are subject to operating rules and pilot and equipment requirements specified in FAR Part 91. TCA's are depicted on Sectional, World Aeronautical, En Route Low Altitude and TCA charts. (Refer to FAR Part 91.)

e. Transition Area - Controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed, or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise limited, transition areas terminate at the base of the overlying controlled airspace. Transition areas are designed to contain IFR operatings in controlled airspace during portions of the terminal operations and while transiting between the terminal and en route environment.

Dirigible - A lighter-than-air aircraft, engine propelled, with an inward metal frame which maintains its shape.

Distance Measuring Equipment/DME - Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigation aid.

En Route - The route of flight from point of departure to point of destination, including intermediate stops (excludes local operations).

Executive Transportation - Any use of an aircraft by a corporation, company or other organization for the purposes of transporting its employees and/or property not for compensation or hire and employing professional pilots for the operation of the aircraft.

FAA - Federal Aviation Administration

Fixed-Wing Aircraft - Aircraft having wings fixed to the airplane fuselage and outspread in flight, i.e., nonrotating wings.

Flight Service Station/FSS - Air Traffic Service facilities within the National Airspace System (NAS) which provide preflight pilot briefing and en route communications with VFR flights, assist lost IFR/VFR aircraft, assist aircraft having emergencies, relay ATC clearances, originate, classify, and disseminate Notices to Airmen, broadcast aviation weather and NAS information, receive and close flight plans, monitor radio NAVAIDS, notify search and rescue units of missing VFR aircraft, and operate the national weather teletypewriter systems. In addition, at selected locations FSS's take weather observations, issue airport advisories, administer airman written examinations, advise Customs and Immigrations of transborder flight.

General Aviation/GA - That portion of civil aviation which encompasses all facets of aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board, and large aircraft commercial operators.

General Aviation Aircraft - All civil aircraft except those classified as air carrier.

Group 1 Terminal Control Area - A TCA representing one of the nine busiest locations in the U.S. in terms of aircraft operations and passengers carried within which it is necessary for safety reasons to have strict requirements for operation.

Group II Terminal Control Area - A TCA representing one of the twelve less busy locations than a Group I TCA and requiring less stringent pilot and equipment requirements.

Group III Terminal Control Area - One of the 43 least busy TCA's where an ARTS-III system exists.

IFR Conditions - Weather conditions below the minimum for flight under visual rules.

Industrial/Special - Any use of an aircraft for specialized work allied with industrial activity excluding transportation and aerial application. (Examples: pipe line patrol; survey; advertising; photography; helicopter hoist; etc.)

Instructional Flying - Any use of an aircraft for the purposes of formal instruction with the flight instructor aboard, or with the maneuvers on the particular flight(s) specified by the flight instructor.

Instrument Flight Rules/IFR - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan (See Visual Flight Rules).

Instrument Landing System/ILS - A precision instrument approach system consisting of the following electronic components and visual aids:

a. Localizer
b. Glide Slope
c. Outer Marker
d. Middle Marker
e. Approach Lights

Refer to FAR Part 91.

Jet Route - A route designed to serve aircraft operations from 18,000 feet MSL up to and including flight level 450. The routes are referred to as "J" routes with numbering to identify the designated route, e.g., J 105. (Refer to FAR Part 71.)

Low Altitude Airway Structure/Federal Airways - The network of airways serving aircraft operations up to but not including 18,000 feet MSL. (See Airway.)

Microwave Landing System/MLS - An instrument landing system operating in the microwave spectrum which provides lateral and vertical guidance to aircraft having compatible avionics equipment. (See Instrument Landing System.)

Non-Positive Controlled Airspace - Controlled airspace below 18,000 feet MSL.

Personal and Pleasure Flying - Any use of an aircraft for personal purposes not associated with business or profession, and not for hire. This includes maintenance of pilot proficiency.

Pilot Briefing - Information furnished a pilot to assist in flight planning. Principal items are weather conditions, notices to airmen, routes, and preparation and handling of the flight plan.

Piston-Powered Aircraft - An aircraft operated by engines in which pistons moving back and forth work upon a crank shaft or other device to create rotational movement.

Positive Controlled Area/PCA - Airspace designated in FAR Part 71 wherein aircraft are required to be operated under Instrument Flight Rules (IFR). Vertical extent of PCA is from 18,000 feet to and including flight level 600 throughout most of the conterminous United States and from flight level 240 to and including flight level 600 in designated portions of Alaska.

Radio Altimeter/Radar Altimeter - Aircraft equipment which makes use of the reflection of radio waves from the ground to determine the height of the aircraft above the surface.

Region (FAA) - A principal subdivision of the Federal Aviation Administration organized to carry out FAA programs under the executive direction of a regional director within the specific geographic boundaries.

Registered Aircraft - Aircraft registered with FAA.

Rotorcraft - A heavier-than-air aircraft that derives lift from one or more revolving "wings" or blades, engine-driven above an approximately vertical axis. A rotorcraft does not have conventional fixed wings, nor in any but some earlier models is provided with a conventional propeller, forward thrust and lift being furnished by the rotor. The powered rotor blades also enable the machine to hover, and to land and take off vertically.

Transponder - The airborne radar beacon receiver/transmitter portion of the Air Traffic Control Radar Beacon System (ATCRBS), which automatically receives signals from interrogations being received on the mode to which it is set to respond.

Turbine-Powered Aircraft - Includes aircraft with either turbojet, turbofan, turboprop, or turboshaft engines.

Turbojet - Aircraft operated by jet engines incorporating a turbine-driven air compressor to take in and compress the air for the combustion of fuel, the gases of combustion (or the heated air) being used both to rotate the turbine and to create a thrust-producing engine.

Turboprop - Aircraft in which the main propulsive force is supplied by a gas turbine-driven conventional propeller. Additional propulsive force may be supplied from the discharge turbine engine gas.

Uncontrolled Airport - Also known as a non-tower airport, an airport at which no control tower is in operation. It may have an FSS, UNICOM operator, or no facility at all.

Uncontrolled Airspace - That portion of the airspace that has not been designated as continental control area, control area, control zone, terminal control area, or transition area. (See Controlled Airspace).

UNICOM - A non-government air/ground radio communication facility, which may provide airport advisory service at certain airports. Locations and frequencies of UNICOM's are shown on aeronautical charts and publications.

U.S. Civil Aircraft Fleet - All aircraft under U.S. registry exclusive of Military.

Visual Flight Rules/VFR - Rules that govern the procedures for conducting flight under visual conditions. It is used by pilots and controllers to indicate the type of Flight Plan. (See Instrument Flight Rules). (Refer to FAR Part 91.)

VOR Airway - Low altitude airway designated from 1,200 feet AGL to 18,000 feet MSL predicated on VOR/VORTAC navigation aids. Also known as a "Victor" airway, it is indicated by a "V" on aeronautical charts and is numbered similarly to the U.S. highway system.

VOR/Very High Frequency Omnidirectional Range Station - A ground-based electronic navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the national airspace system. The VOR periodically identifies itself by morse code and may have an additional voice identification feature. Voice features may be used by ATC or FSS for transmitting instructions/information to pilots.

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